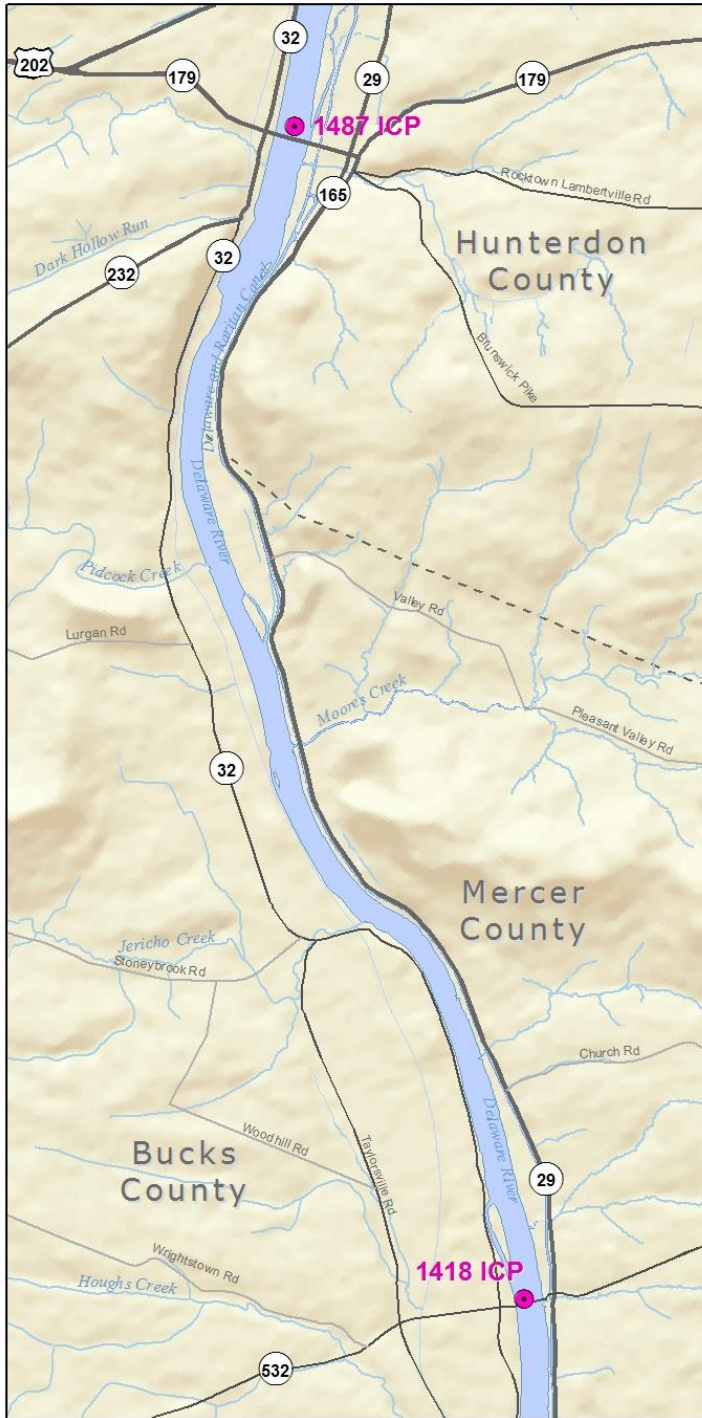


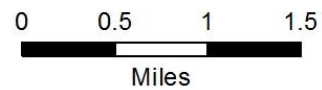
Chapter 2: 1418 ICP Delaware River at Washington Crossing, NJ/PA



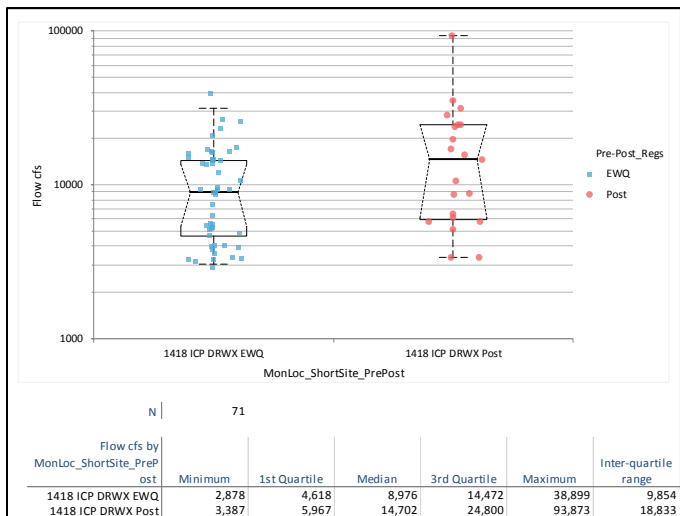
1418 ICP
Delaware River at Washington Crossing Bridge



- Sampling Location
- - - County Boundary



Analysis of flow differences between the EWQ and post-EWQ monitoring periods:



Kruskal-Wallis test

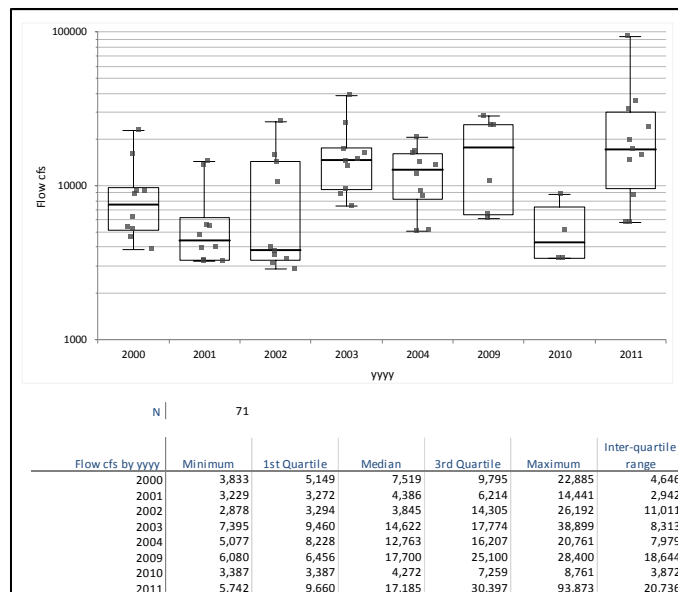
Flow cfs by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	544.5	10.89
1418 ICP DRWX Post	21	1296.4	61.73

H statistic: 4.32
 X² approximation: 4.32
 DF: 1
 p-value: 0.0376¹

H0: $\theta_1 = \theta_2 = \theta...$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.

¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

Flow was different between the two periods at this location. Overall EWQ flow was low to near-normal for the May to September period and post-EWQ flow was generally above-normal. For flow-related parameters, this difference can lead to misinterpretation of results, so confidence in statistical comparisons is low even in cases where statistical differences are significant. Flow is plotted on a logarithmic scale.



Annual flow statistics are plotted above. Flow is plotted on a logarithmic scale. These are May to September flow measurements associated with the time of each water quality sample. Flow is estimated at this location using drainage area weighting based on the USGS continuous stream gage at Trenton, NJ. “Normal” flow is about 10,000 cfs at this location on the Delaware River.

Within the data, annual summer flow is below normal for 4 years and above normal for 4 years. When examining annual summer Washington Crossing water quality statistics between the EWQ and post-EWQ periods, post-EWQ water quality is likely most comparable to EWQ 2003-2004 data when flow was above normal.

Upstream ICP: Delaware River at Lambertville 1487 ICP
 Downstream ICP: Delaware River at Trenton 1343 ICP

Tributary BCP Watersheds in Upstream Reach:

Pidcock Creek, PA – 1463 BCP

All other tributary watersheds to the upstream reach are less than 20 square miles drainage area, possess no wastewater discharges, and are expected to exert minimal water quality influence upon the Delaware River.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

Alkalinity as CaCO₃, Total mg/l

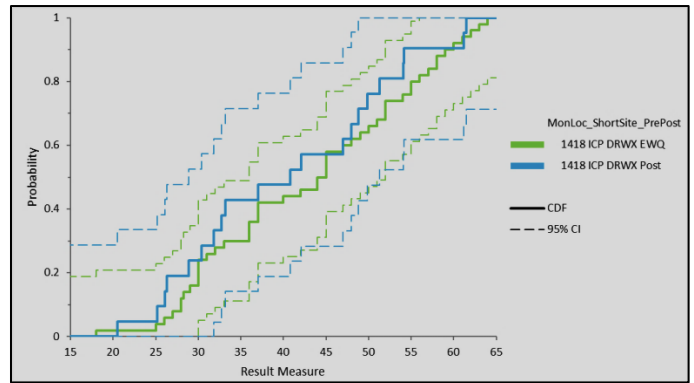
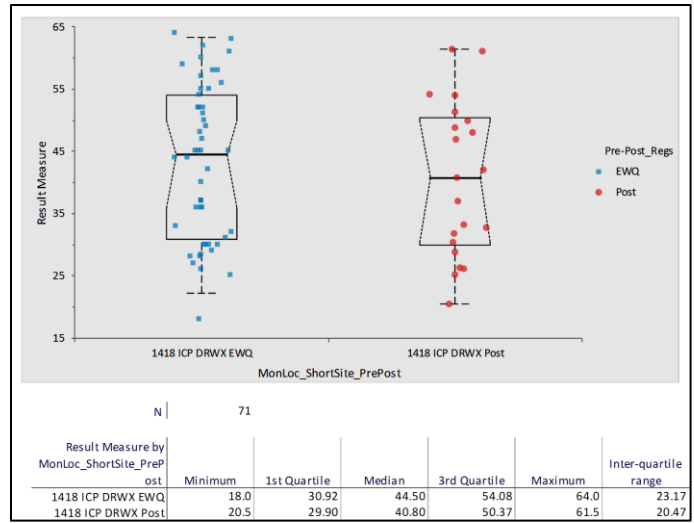
Existing Water Quality (Table 2Y):

Median 45 mg/l

Lower 95% Confidence Interval 36 mg/l

Upper 95% Confidence Interval 50 mg/l

Defined in regulations as a flow-related parameter



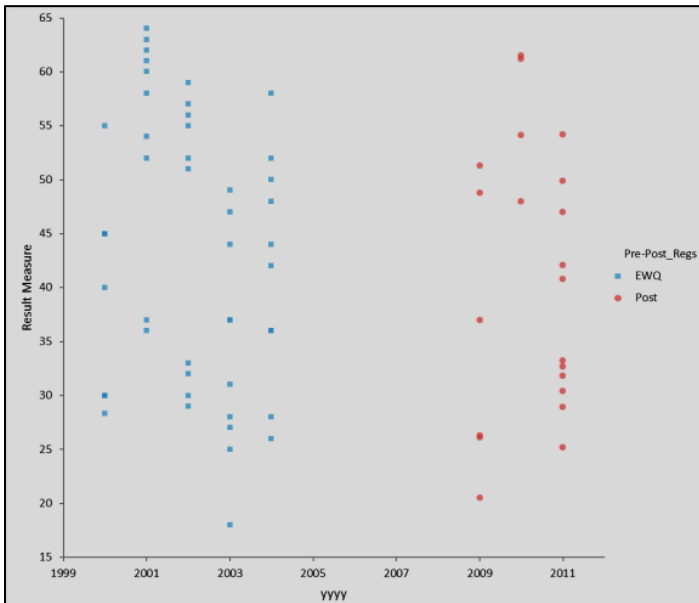
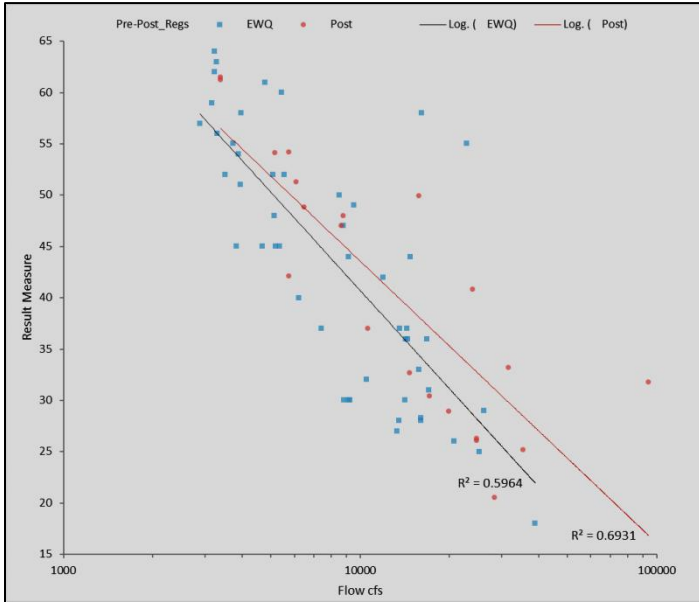
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	80.6	1.61
1418 ICP DRWX Post	21	192.0	9.14

H statistic: 0.64
 X² approximation: 0.64
 DF: 1
 p-value: 0.4235¹

H0: $\theta_1 = \theta_2 = \theta...$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Alkalinity did not measurably change between the EWQ and post-EWQ periods. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. Alkalinity is inversely related to flow.

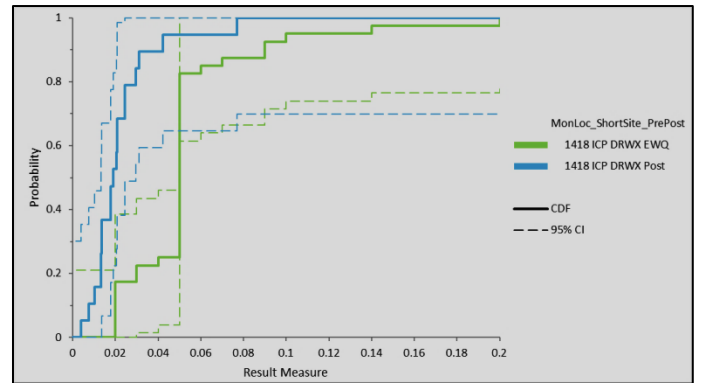
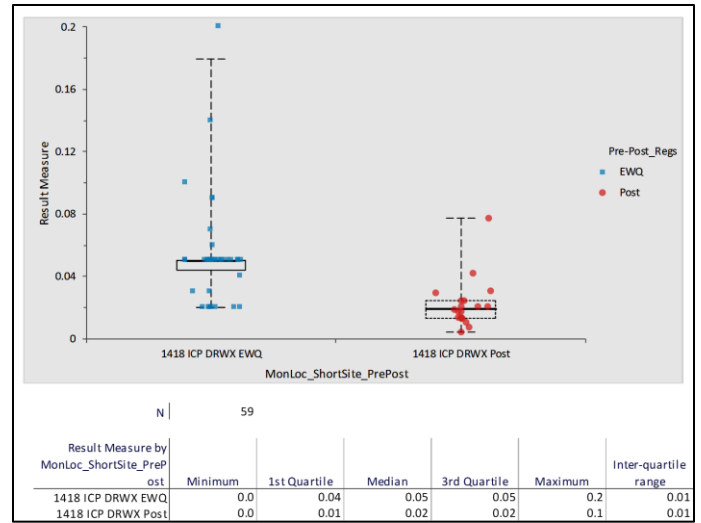
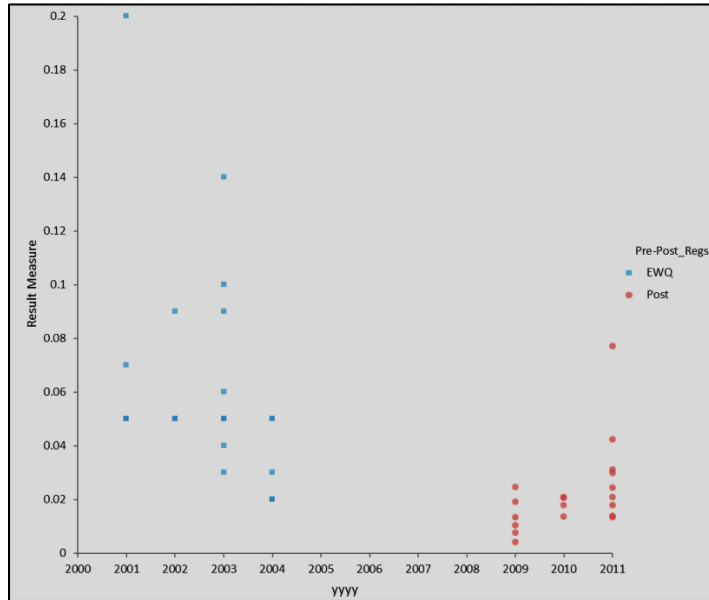
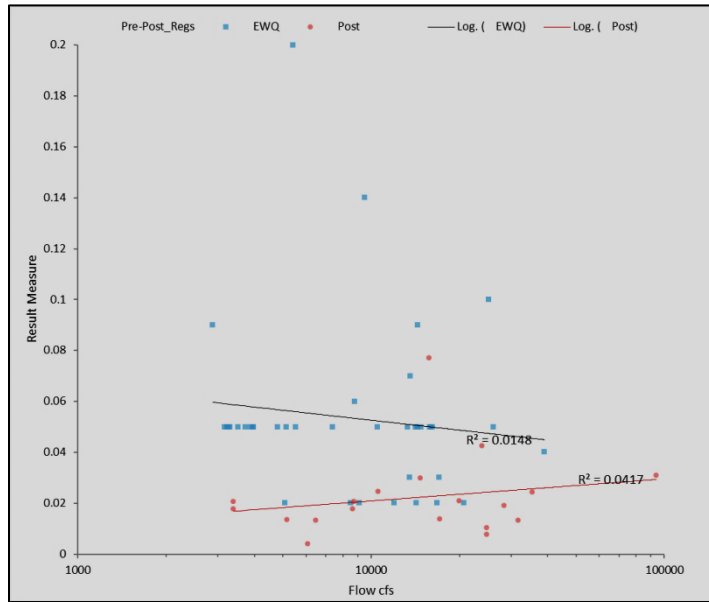


Chapter 2: 1418 ICP
 Delaware River at Washington Crossing Bridge

Ammonia Nitrogen as N, Total mg/l

Existing Water Quality (Table 2Y):

Median <0.05 mg/l
 Lower 95% Confidence Interval <0.05 mg/l
 Upper 95% Confidence Interval 0.09 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	40	2016.4	50.41
1418 ICP DRWX Post	19	4245.1	223.42

H statistic: 22.60
 X² approximation: 22.60
 DF: 1
 p-value: <0.0001¹

H0: $\theta_1 = \theta_2 = \theta_3$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

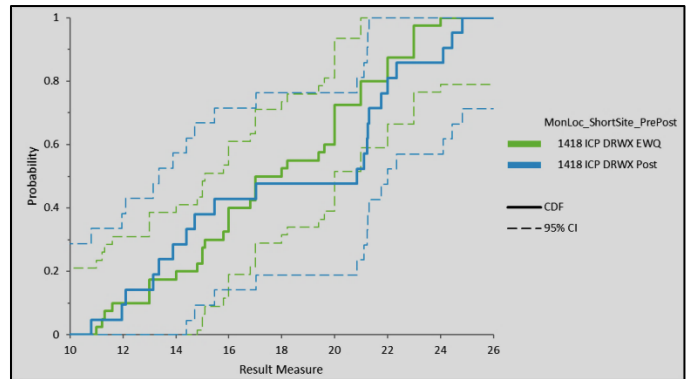
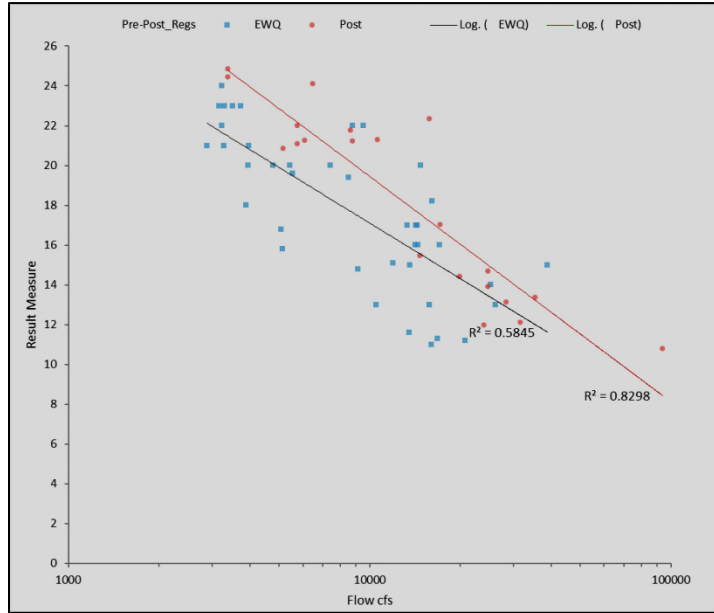
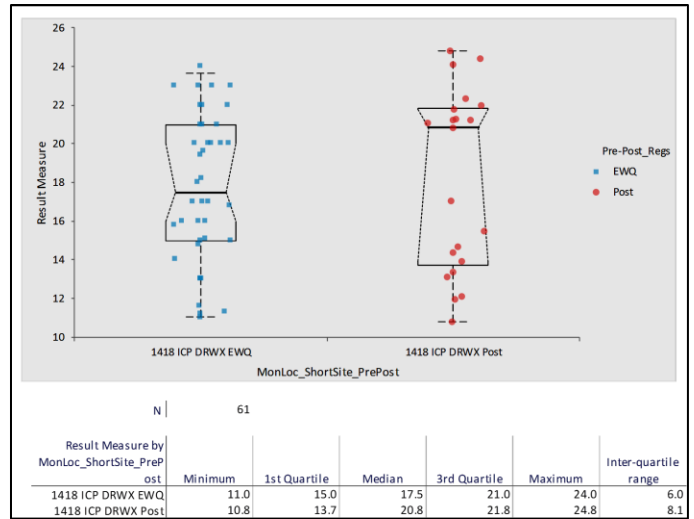
No water quality degradation is indicated. Ammonia concentrations appeared to decline, though differences in flow conditions, detection limits and potential laboratory artifacts produced uncertainty. No independent data were available to validate the decline. EWQ data possessed 29/40 undetected results that interfered with estimation of the median and its confidence intervals. There was 1 non-detect result in the post-EWQ samples. We are now able to measure ammonia at lower concentrations. However, some water quality improvement is indicated by the lack of high values in the post-EWQ data.

Chapter 2: 1418 ICP
 Delaware River at Washington Crossing Bridge

Chloride, Total mg/l

Existing Water Quality (Table 2Y):

Median 18 mg/l
 Lower 95% Confidence Interval 16 mg/l
 Upper 95% Confidence Interval 20 mg/l
 Defined in regulations as a flow-related parameter

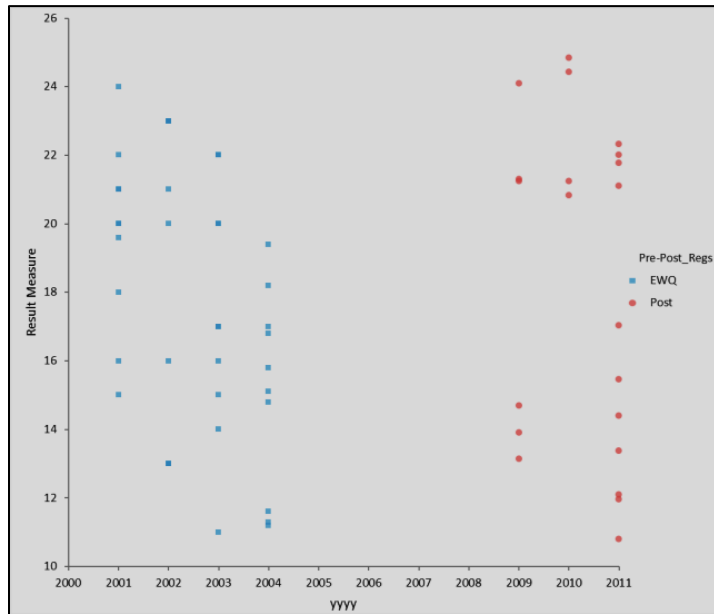


Kruskal-Wallis test

MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	40	27.2	0.68
1418 ICP DRWX Post	21	51.9	2.47

H statistic | 0.25
 X² approximation | 0.25
 DF | 1
 p-value | 0.6162¹

H0: $\theta_1 = \theta_2 = \theta...$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.



Some evidence of water quality degradation is indicated, although chloride concentrations did not measurably change between the two periods. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. Though post-EWQ median concentration rose by 3 mg/l, which is above the EWQ upper 95% confidence interval, the difference was not statistically significant due to fewer samples taken during the post-EWQ period.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

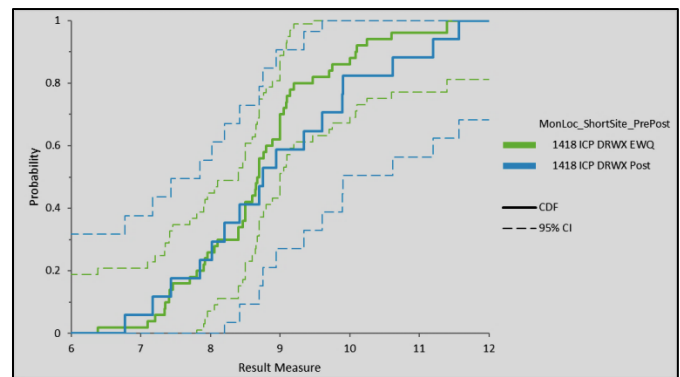
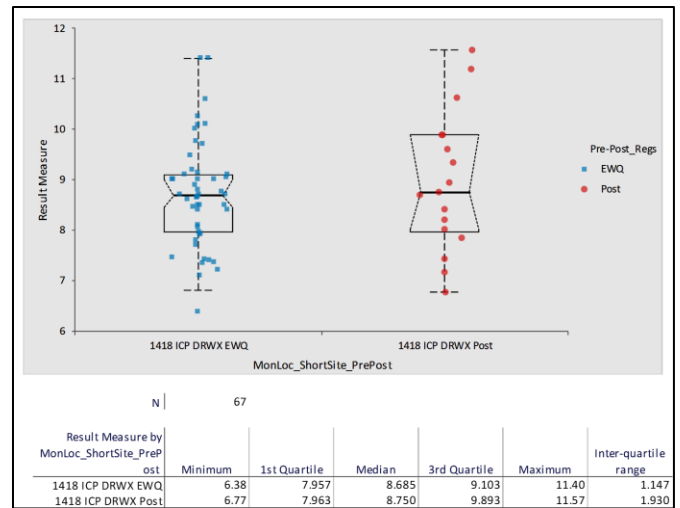
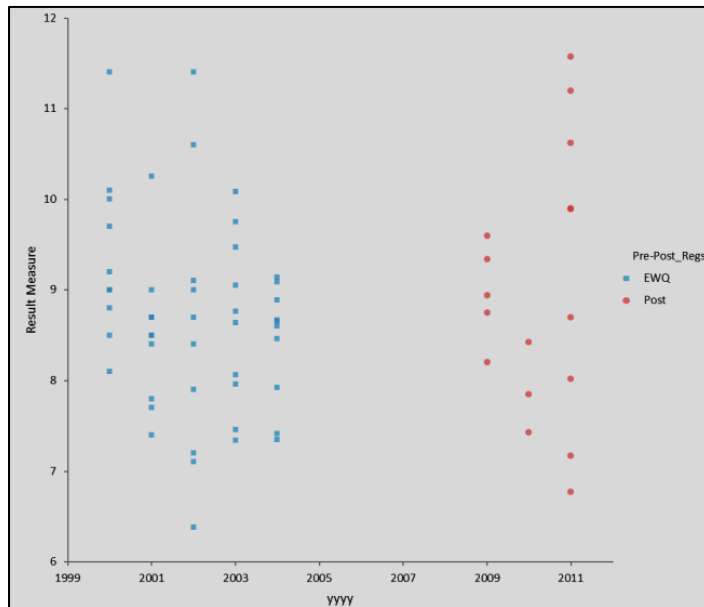
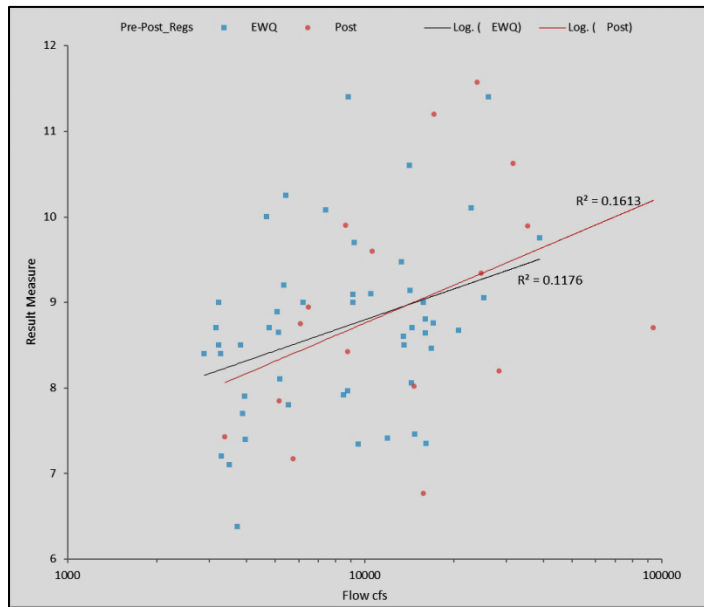
Dissolved Oxygen (DO) mg/l

Existing Water Quality (Table 2Y):

Median 8.69 mg/l

Lower 95% Confidence Interval 8.46 mg/l

Upper 95% Confidence Interval 9.00 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	29.6	0.59
1418 ICP DRWX Post	17	87.2	5.13

H statistic | 0.31
 X² approximation | 0.31
 DF | 1
 p-value | 0.5790¹
 H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i, j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

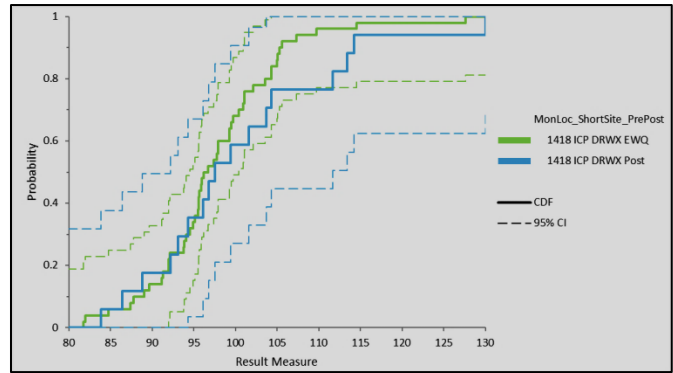
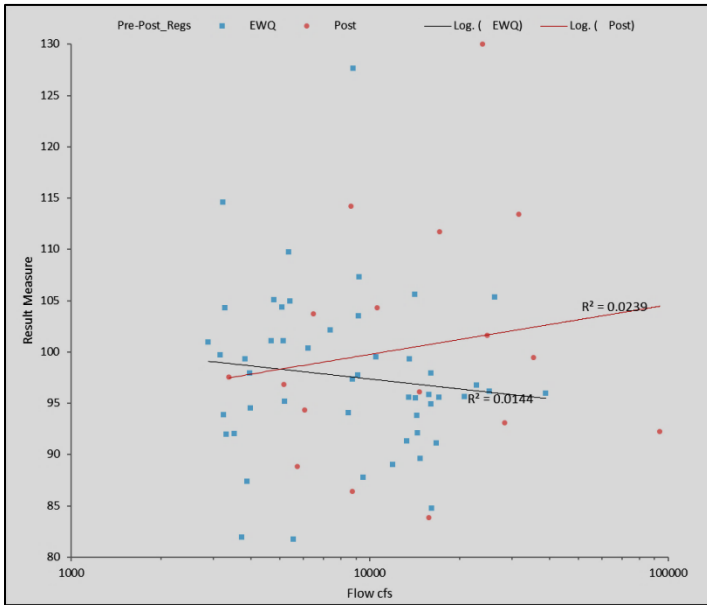
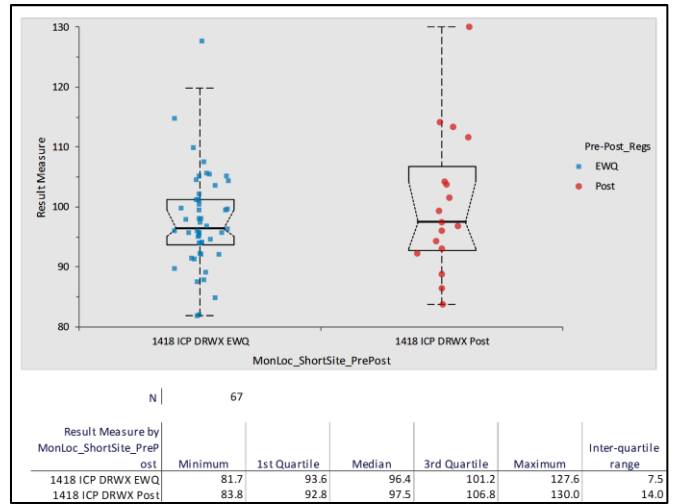
No water quality degradation is indicated. No measurable change took place between the EWQ and Post-EWQ periods. Post-EWQ median DO concentration fell within the EWQ 95% confidence intervals, and the data distributions of the two periods were similar. DO was unrelated to flow in both data sets.

Chapter 2: 1418 ICP
 Delaware River at Washington Crossing Bridge

Dissolved Oxygen Saturation %

Existing Water Quality (Table 2Y):

- Median 96%
- Lower 95% Confidence Interval 95%
- Upper 95% Confidence Interval 99%



Kruskal-Wallis test

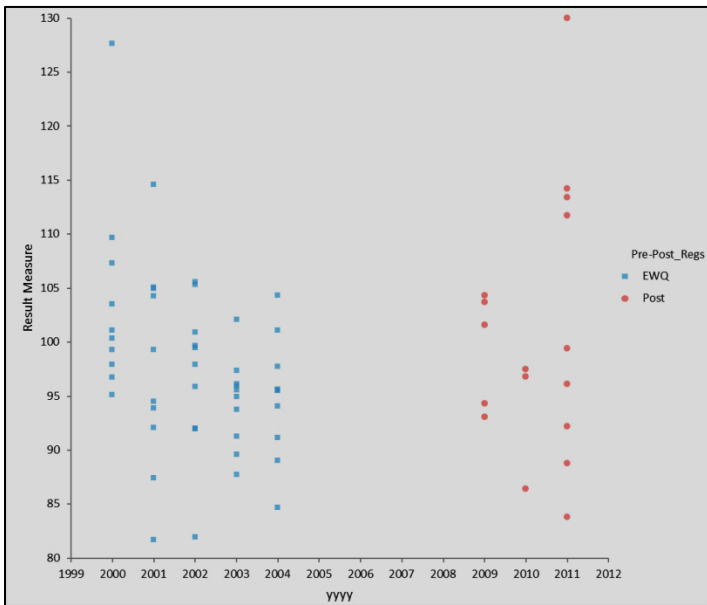
Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	42.3	0.85
1418 ICP DRWX Post	17	124.5	7.32

H statistic 0.44
 X² approximation 0.44
 DF 1
 p-value 0.5075¹

H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.

¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Dissolved Oxygen Saturation is unrelated to flow, and did not measurably change between the EWQ and post-EWQ periods. DO saturation ranged widely in 2011, possibly indicating higher than usual primary productivity by algae and plant activity that summer.



Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

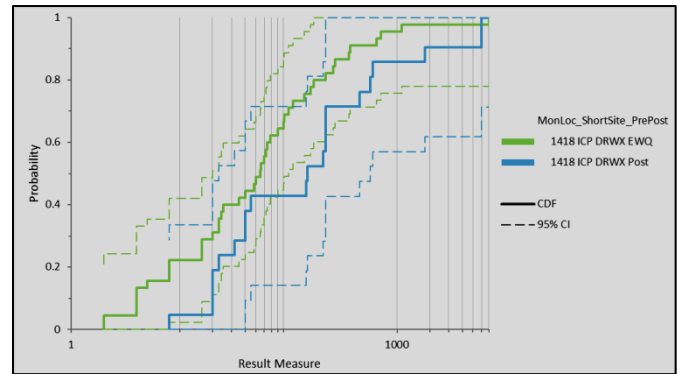
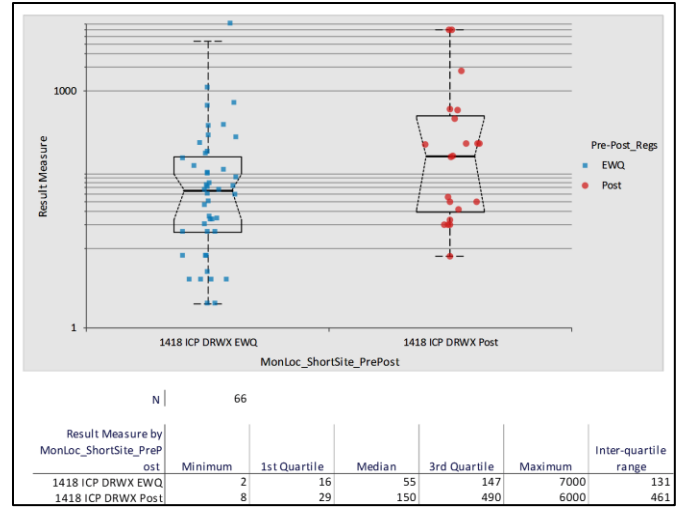
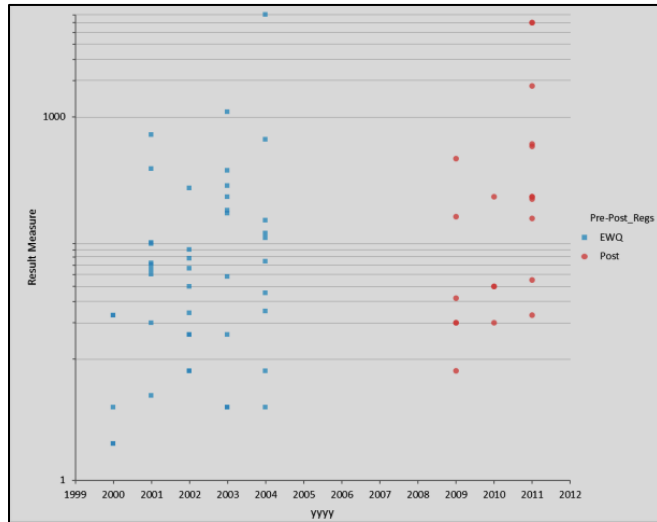
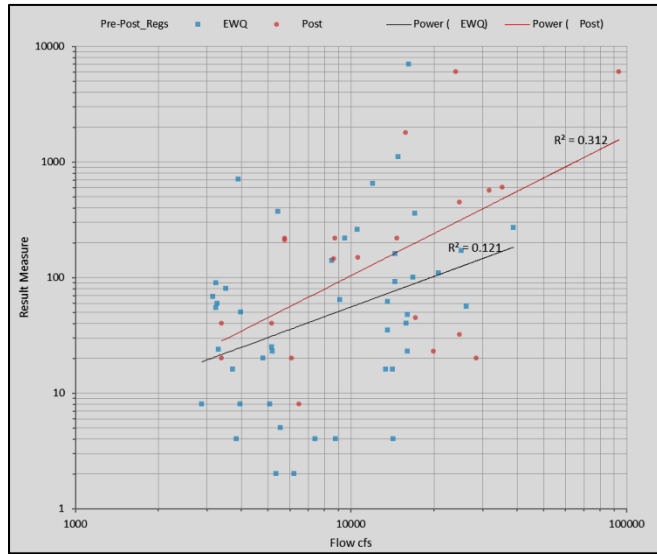
Enterococcus colonies/100 ml

Existing Water Quality (Table 2Y):

Median 55/100 ml

Lower 95% Confidence Interval 23/100 ml

Upper 95% Confidence Interval 90/100 ml



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	45	417.1	9.27
1418 ICP DRWX Post	21	893.8	42.56

H statistic: 3.56
 χ^2 approximation: 3.56
 DF: 1
 p-value: 0.0591¹

H0: $\theta_1 = \theta_2 = \theta...$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Enterococci did not measurably change between the EWQ and Post-EWQ periods, but the median for the post-EWQ period was higher than the upper 95% confidence interval established in the rules. There may have been an increase, but high variability and smaller post-EWQ N produced statistical uncertainty. Dry-weather samples are under-represented in post-EWQ data. Enterococcus concentrations are positively related to flow in the post-EWQ data set, but the regression is driven by an outlier sample taken during flood conditions. Concentrations are plotted on a logarithmic scale.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

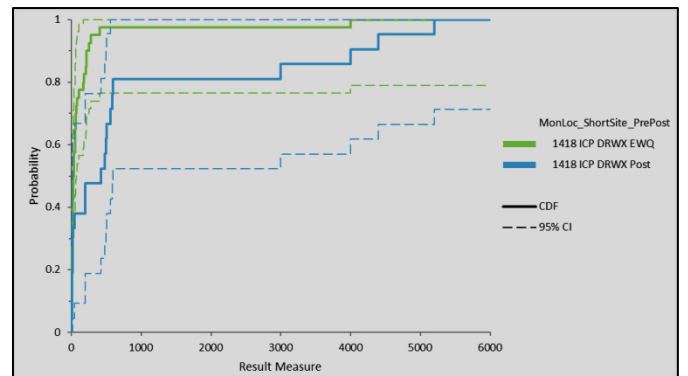
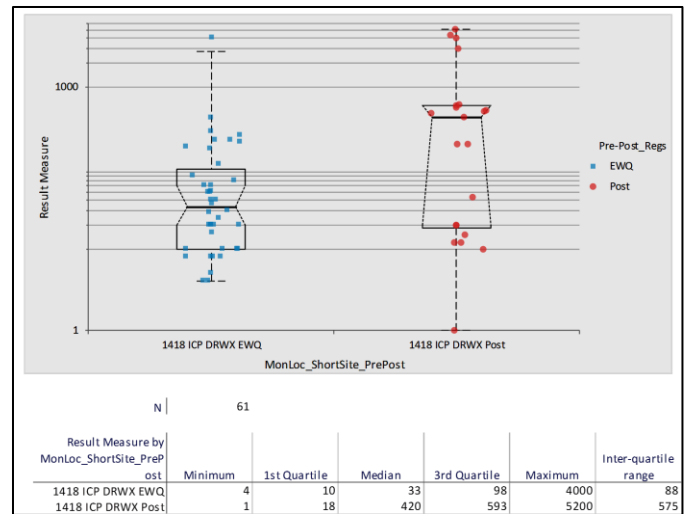
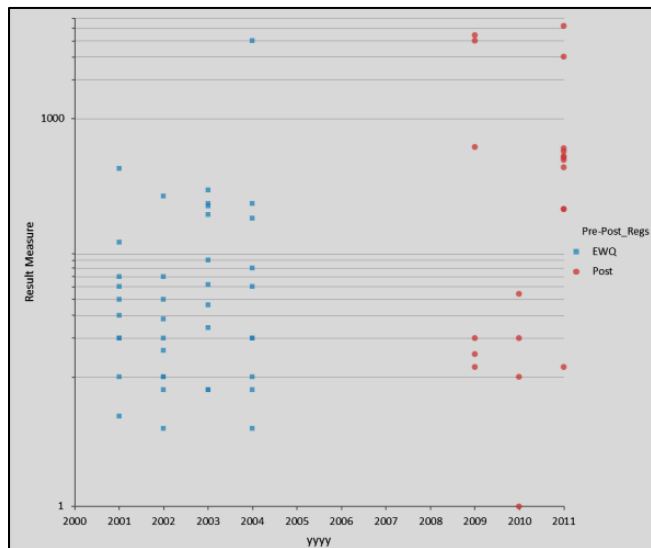
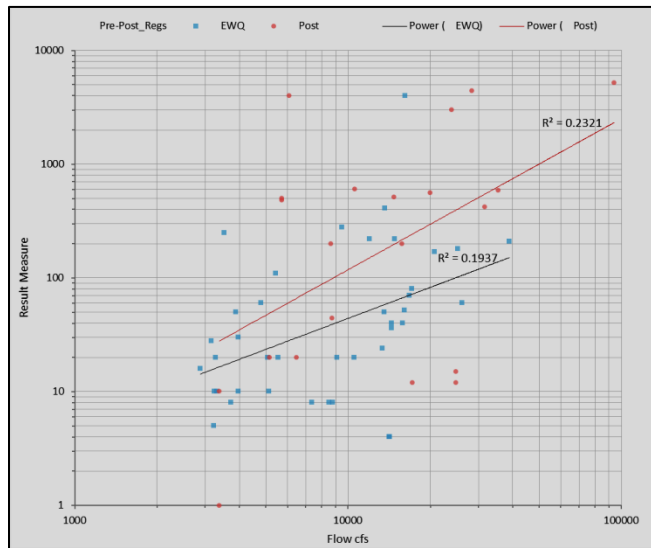
Escherichia coli colonies/100 ml

Existing Water Quality (Table 2Y):

Median 33/100 ml

Lower 95% Confidence Interval 20/100 ml

Upper 95% Confidence Interval 60/100 ml



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	40	735.3	18.38
1418 ICP DRWX Post	21	1400.6	66.69

H statistic 6.79
 X² approximation 6.79
 DF 1
 p-value 0.0091¹

H0: $\theta_1 = \theta_2 = \theta...$

The median of the populations are all equal.

H1: $\theta_i \neq \theta_j$ for at least one i, j

The median of the populations are not all equal.

¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

E. coli concentrations apparently rose between the EWQ and Post-EWQ periods. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. There is a weak relationship of E. coli to flow, and dry weather samples were under-represented in the post-EWQ data.

No independent data were available at this site to validate DRBC results. The increase is reported as such in the summary matrix, but confidence is low because of low N and high variability. The reason for the increase remains unexplained other than the prevalence of higher flow conditions in the post-EWQ period.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

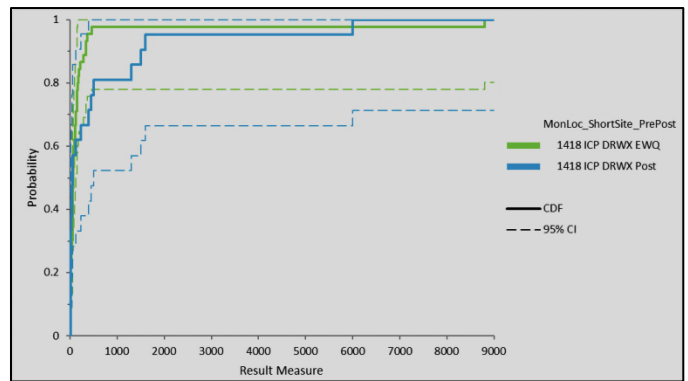
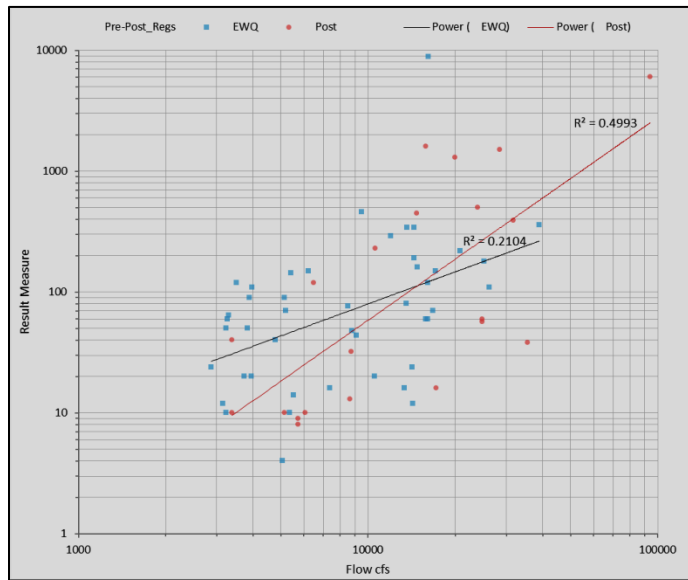
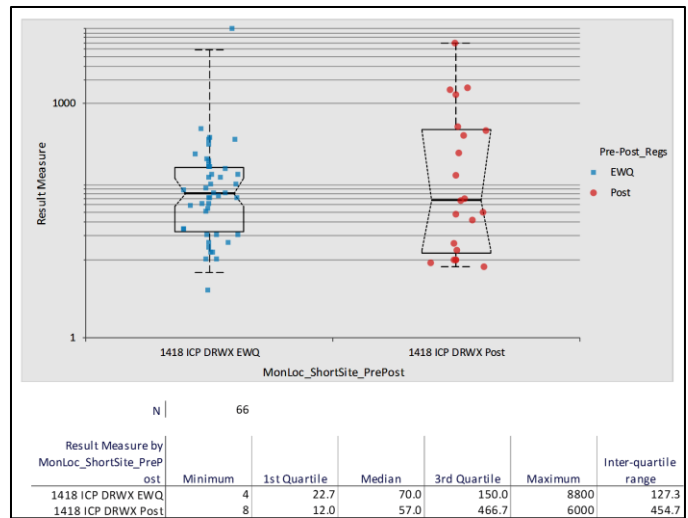
Fecal coliform colonies/100 ml

Existing Water Quality (Table 2Y):

Median 70/100 ml

Lower 95% Confidence Interval 48/100 ml

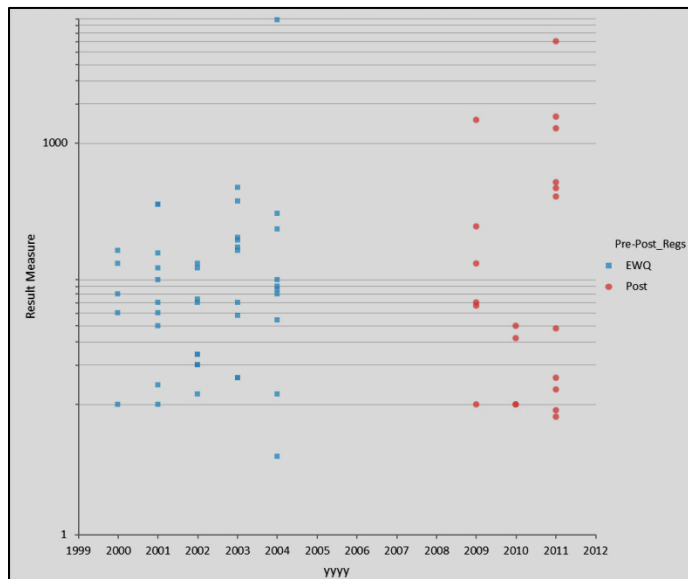
Upper 95% Confidence Interval 110/100 ml



Kruskal-Wallis test

MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	45	0.0	0.00
1418 ICP DRWX Post	21	0.0	0.00

H statistic 0.00
 X² approximation 0.00
 DF 1
 p-value 0.9945¹
 H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.



Fecal coliform concentrations did not measurably change between the EWQ and post-EWQ periods. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. Post-EWQ fecal coliform concentrations are positively related to flow, but the regression is driven by a single outlier sample taken during flood conditions. Post-EWQ median concentrations fell within the EWQ 95% confidence intervals.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

Hardness as CaCO₃, Total mg/l

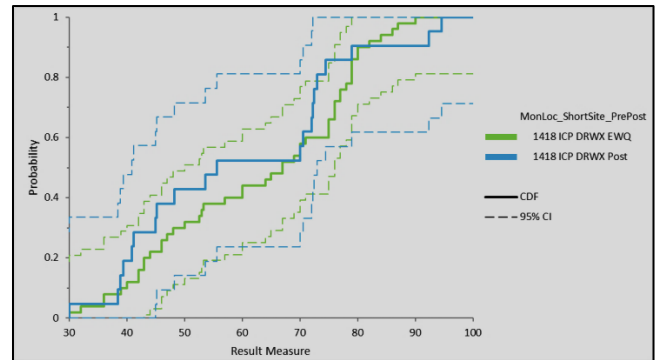
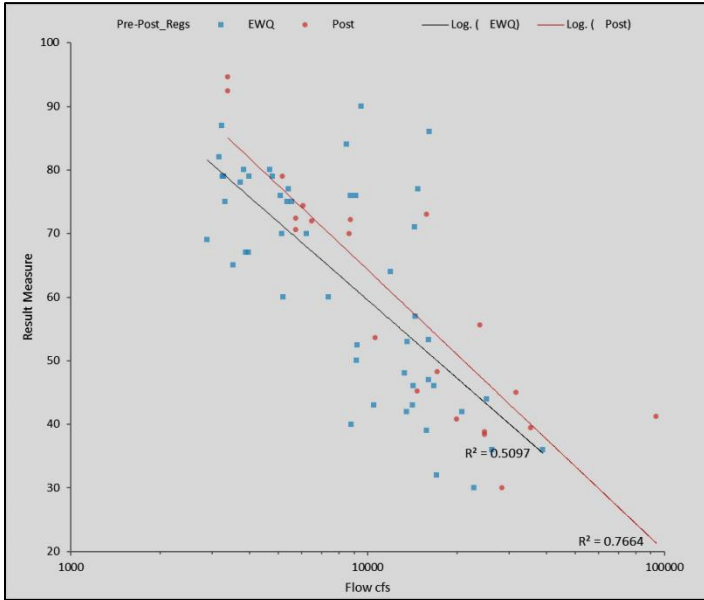
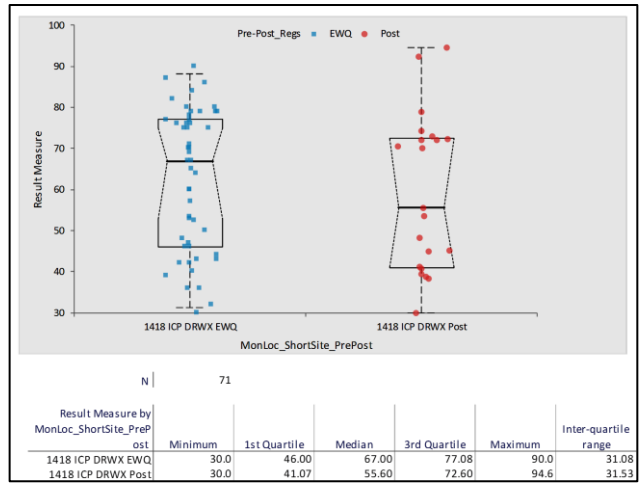
Existing Water Quality (Table 2Y):

Median 67 mg/l

Lower 95% Confidence Interval 53 mg/l

Upper 95% Confidence Interval 75 mg/l

Defined in regulations as a flow-related parameter



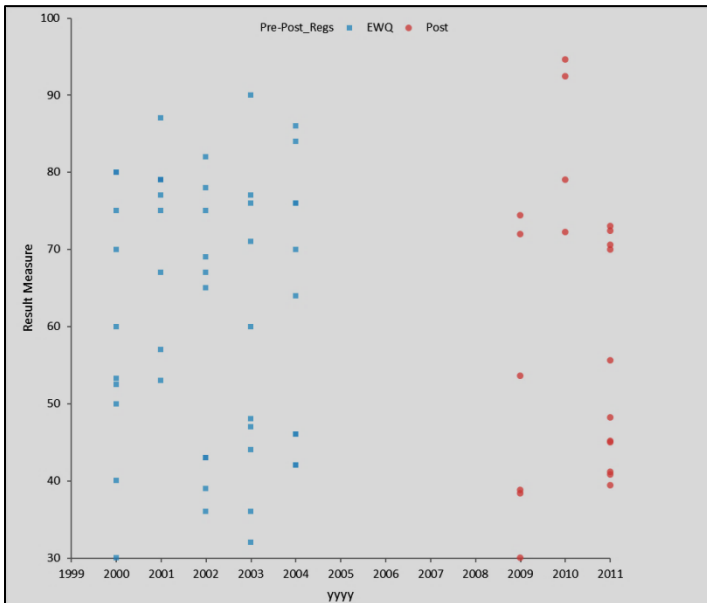
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	117.0	2.34
1418 ICP DRWX Post	21	278.7	13.27

H statistic	0.93
X ² approximation	0.93
DF	1
p-value	0.3350 ¹

H₀: θ₁ = θ₂ = θ_{...}
 The median of the populations are all equal.
 H₁: θ_i ≠ θ_j for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

Hardness did not measurably change between the EWQ and post-EWQ periods. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. Hardness is inversely related to flow. Post-EWQ median hardness fell within the EWQ 95% confidence intervals.



Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

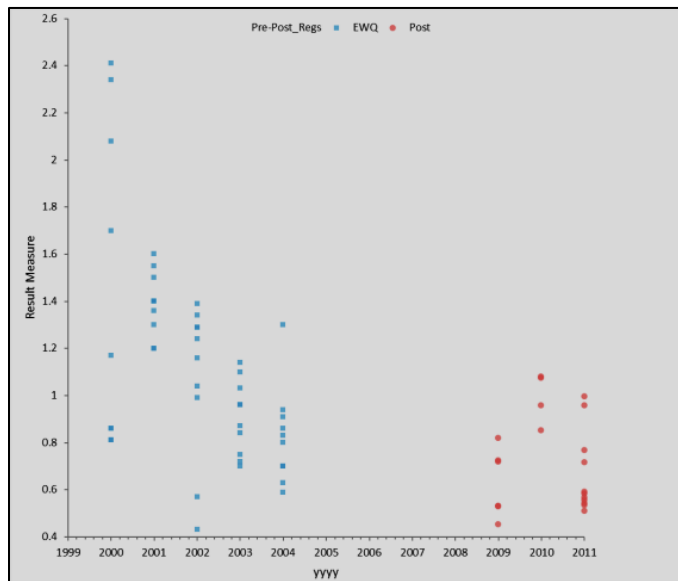
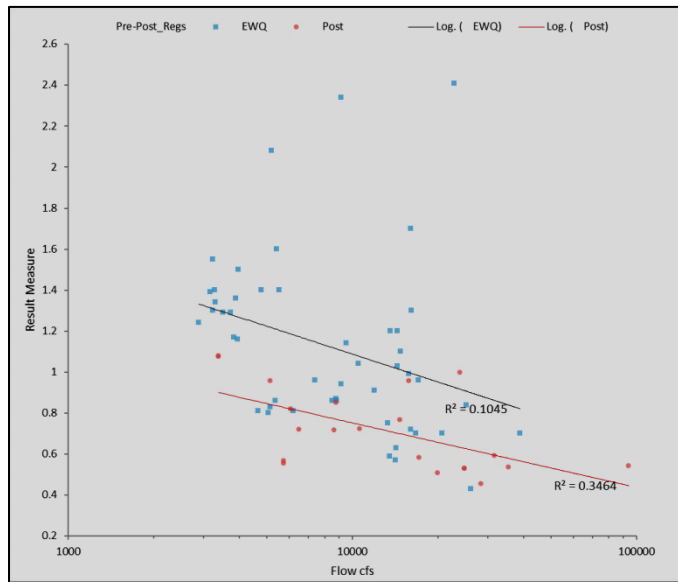
Nitrate + Nitrite as N, Total mg/l

Existing Water Quality (Table 2Y, as Nitrate only):

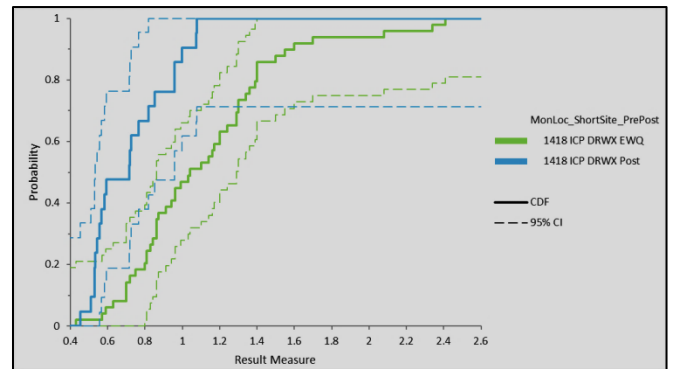
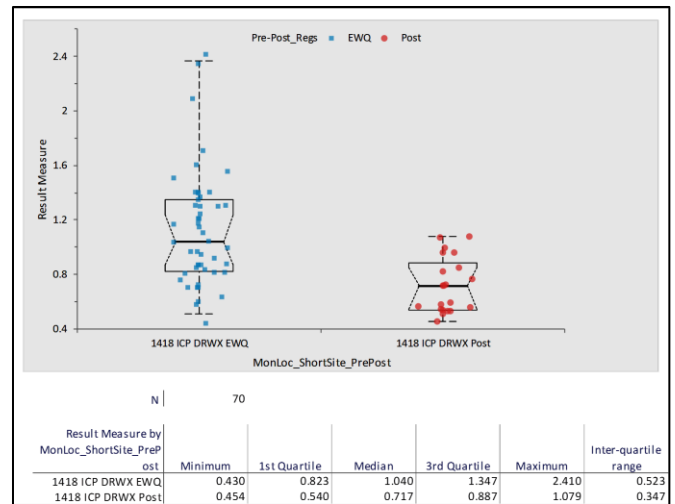
Median 0.99 mg/l

Lower 95% Confidence Interval 0.86 mg/l

Upper 95% Confidence Interval 1.20 mg/l



No water quality degradation is indicated. Nitrate concentrations apparently declined between the EWQ and post-EWQ periods, though flow differences and potential laboratory artifacts as well as low post-EWQ N produced uncertainty.



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	49	2229.2	45.49
1418 ICP DRWX Post	21	5201.4	247.69

H statistic 17.95
 X² approximation 17.95
 DF 1
 p-value <0.0001¹

H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.

¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

On the annual plot there is a declining trend in concentration within the EWQ period that appears to stabilize in the post-EWQ period. 2002-2004 EWQ nitrates appear to match well with post-EWQ nitrate + nitrite. Nitrate + Nitrite concentrations are judged to be equivalent for comparison with EWQ nitrate concentrations, since EWQ nitrite was never detected at this location. Independent data were not available for validation of the apparent decline in nitrate + nitrite concentrations shown by DRBC. Post-EWQ median nitrate + nitrite concentrations fell below the EWQ lower 95% confidence interval.

Chapter 2: 1418 ICP
 Delaware River at Washington Crossing Bridge

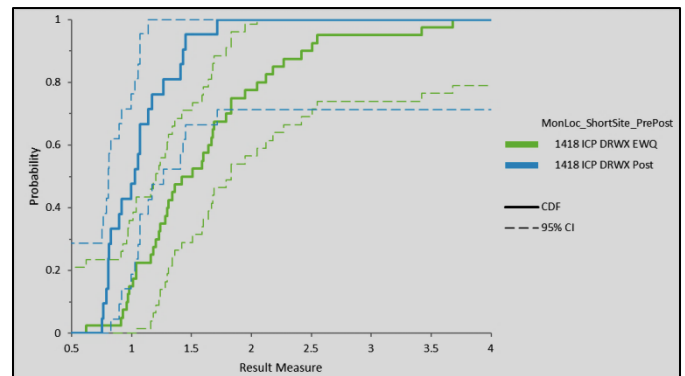
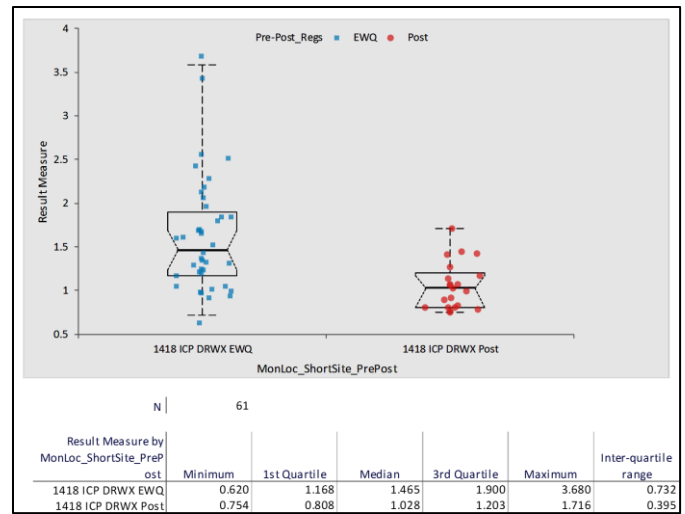
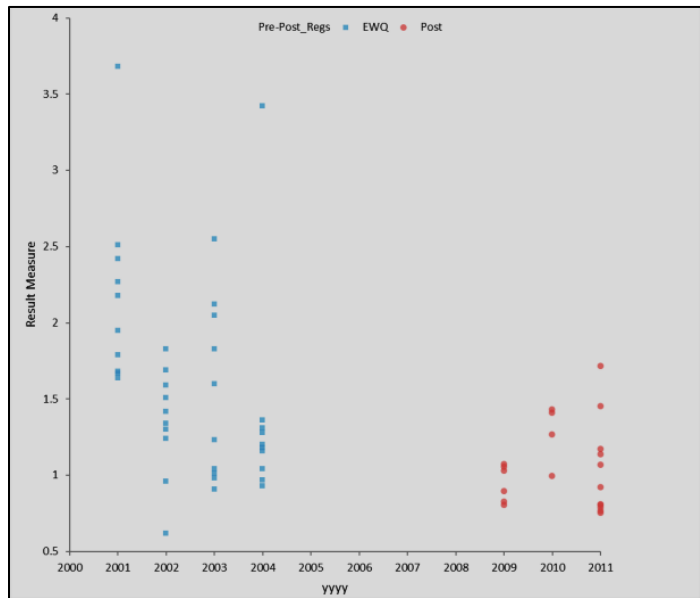
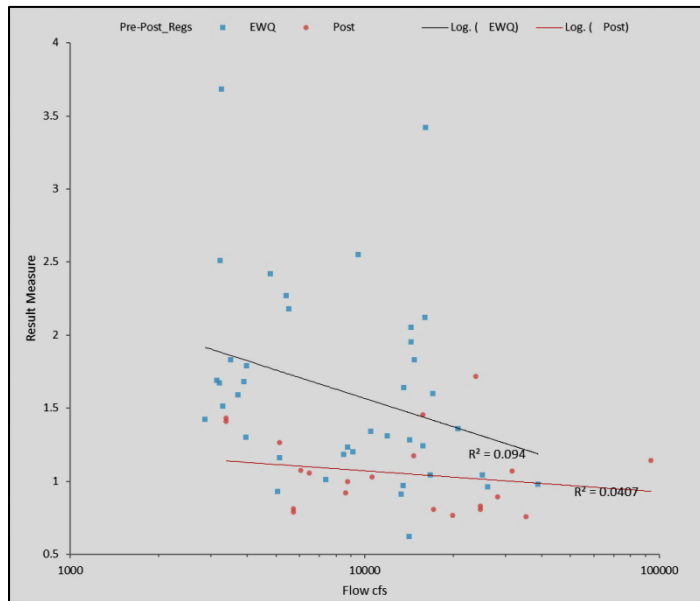
Nitrogen as N, Total (TN) mg/l

Existing Water Quality (Table 2Y):

Median 1.47 mg/l

Lower 95% Confidence Interval 1.24 mg/l

Upper 95% Confidence Interval 1.69 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	40	1575.0	39.38
1418 ICP DRWX Post	21	3000.0	142.86

H statistic 14.52
 X² approximation 14.52
 DF 1
 p-value 0.0001¹

H0: $\theta_1 = \theta_2 = \theta_3 \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.

¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. Total Nitrogen concentrations apparently declined between the EWQ and post-EWQ periods, though flow differences, potential laboratory artifacts, and too few post-EWQ samples produced uncertainty. TN is unrelated to flow in both periods. The EWQ data overall are far more variable than the post-EWQ data. DRBC results could not be independently validated. Post-EWQ median TN concentrations fell below the EWQ lower 95% confidence interval.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

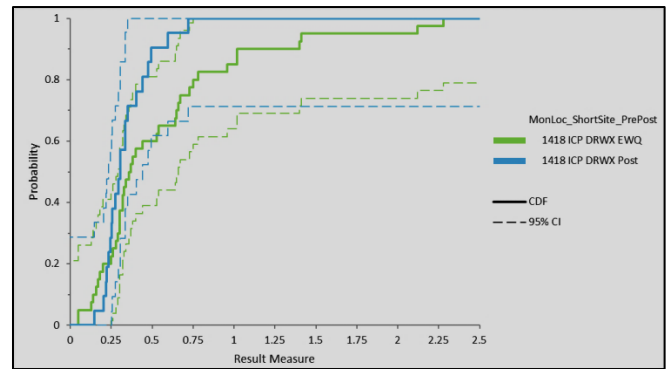
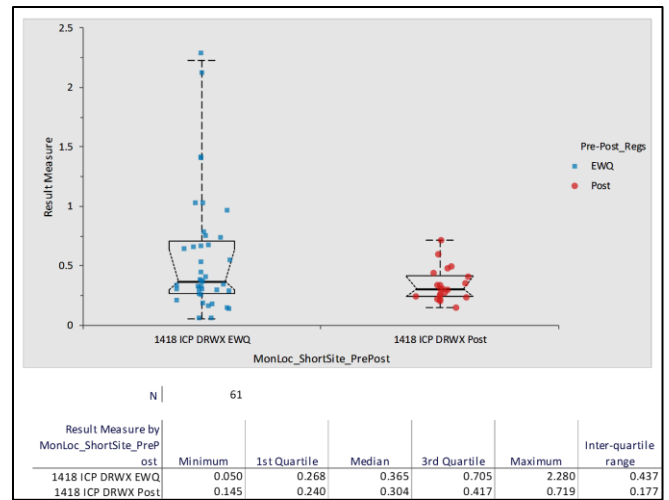
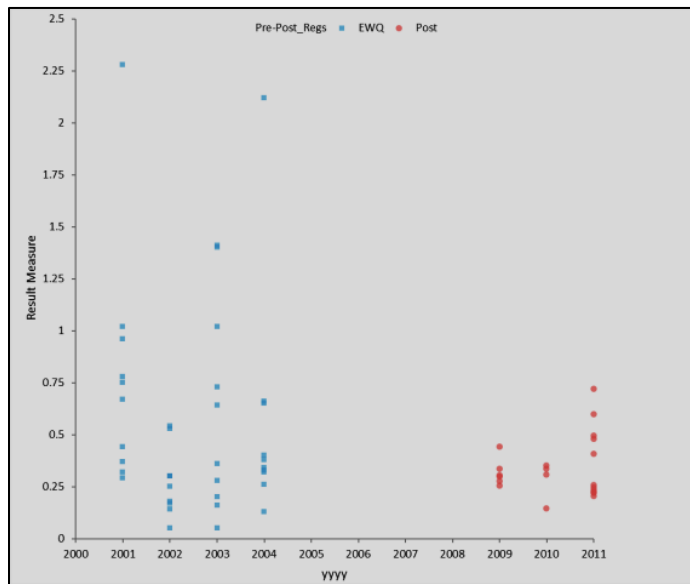
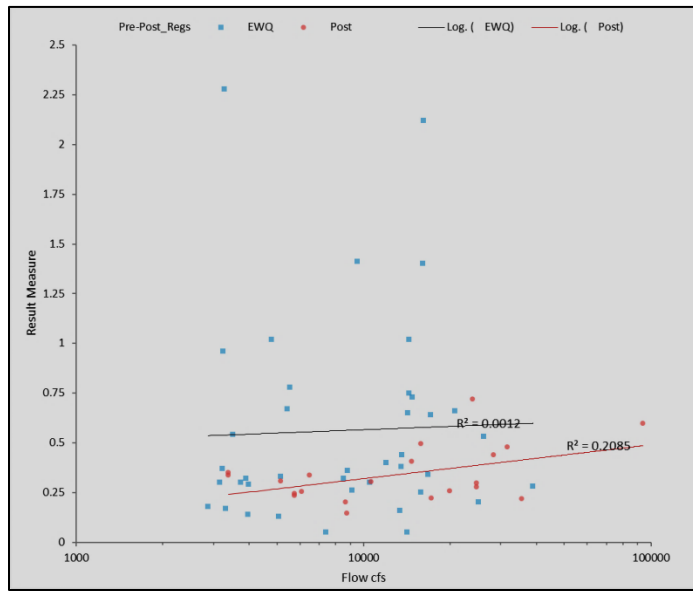
Nitrogen, Kjeldahl as N, Total (TKN) mg/l

Existing Water Quality (Table 2Y):

Median 0.37 mg/l

Lower 95% Confidence Interval 0.30 mg/l

Upper 95% Confidence Interval 0.64 mg/l



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	40	255.0	6.38
1418 ICP DRWX Post	21	485.8	23.13

H statistic	2.35
X ² approximation	2.35
DF	1
p-value	0.1252 ¹

H0: $\theta_1 = \theta_2 = \theta...$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. No measurable change occurred in TKN concentrations between the EWQ and post-EWQ periods. TKN concentration is unrelated to flow in both data sets. Post-EWQ TKN was far less variable than EWQ TKN. Post-EWQ median TKN fell within EWQ 95% confidence intervals, but just barely. Though there was no statistical difference between EWQ and post-EWQ TKN due to fewer post-EWQ data (n=21), concentrations fell somewhat and were far more stable, which may be real or may be a laboratory artifact.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

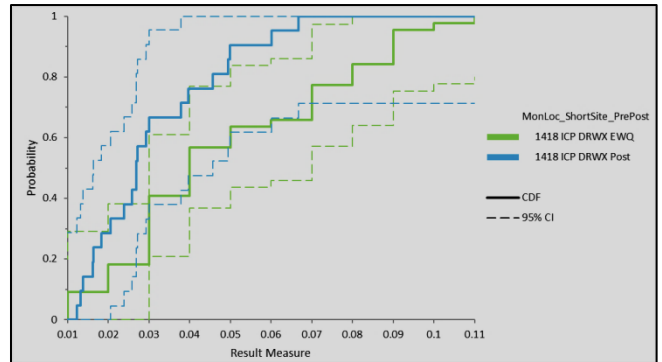
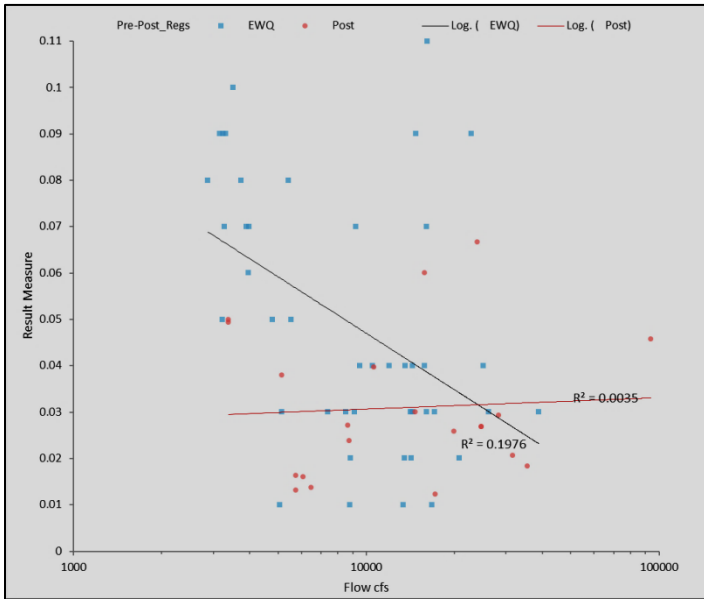
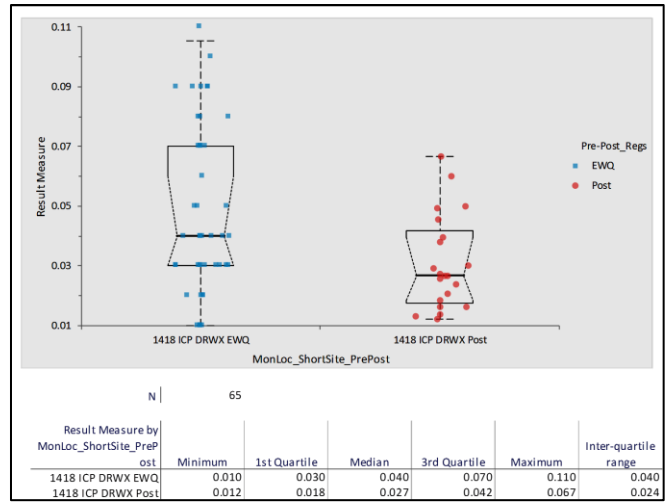
Orthophosphate as P, Total mg/l (OP)

Existing Water Quality (Table 2Y):

Median 0.04 mg/l

Lower 95% Confidence Interval 0.03 mg/l

Upper 95% Confidence Interval 0.06 mg/l



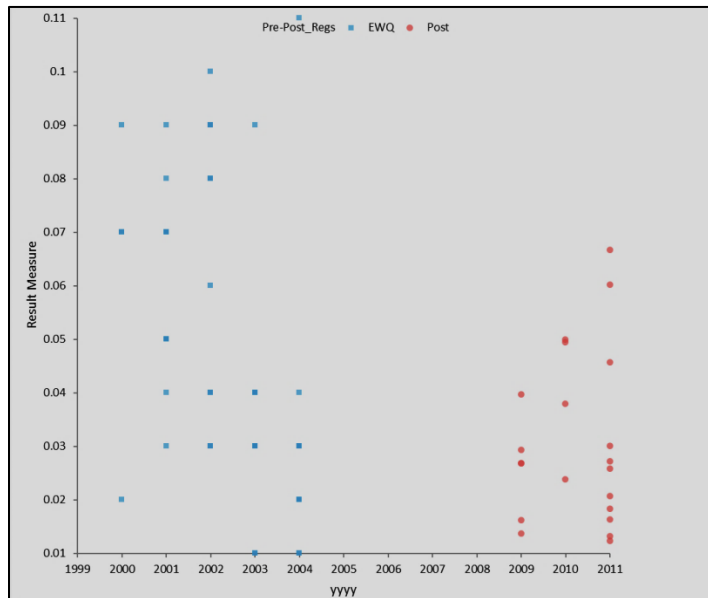
Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	44	909.1	20.66
1418 ICP DRWX Post	21	1904.8	90.70

H statistic 7.93
 X² approximation 7.93
 DF 1
 p-value 0.0049¹

H0: θ₁ = θ₂ = θ₃...
 The median of the populations are all equal.
 H1: θ_i ≠ θ_j for at least one i, j
 The median of the populations are not all equal.

¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.



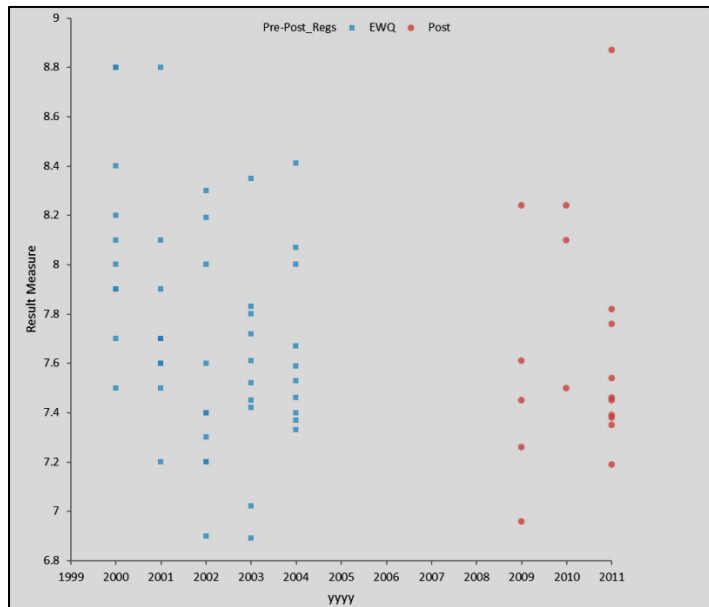
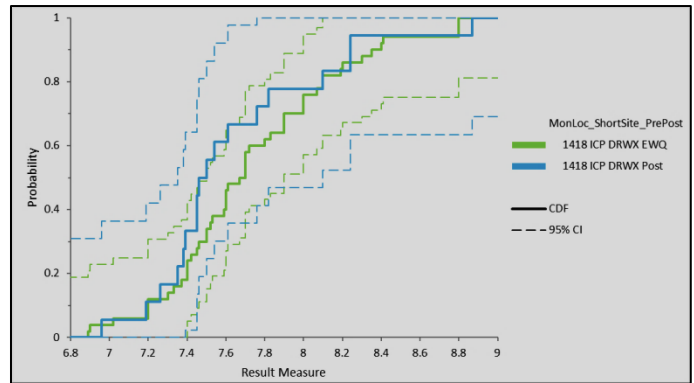
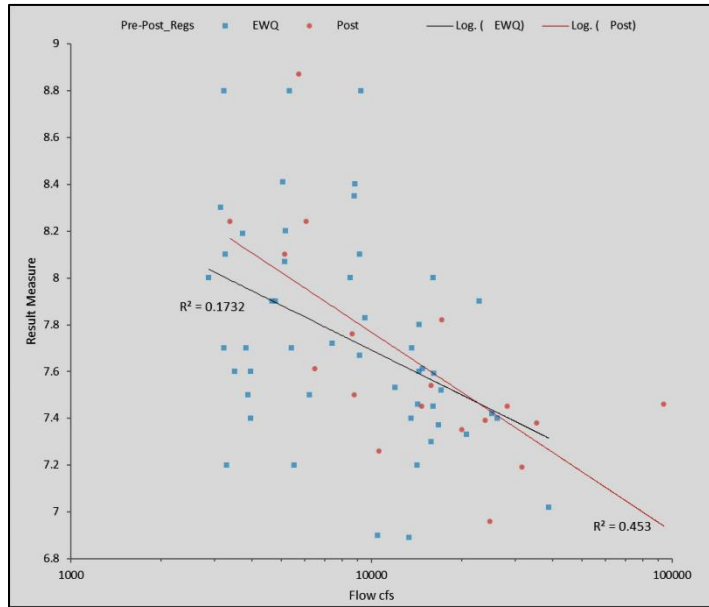
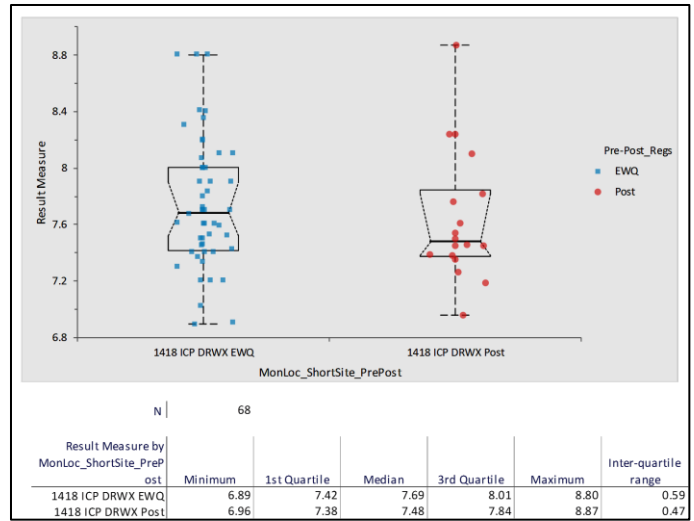
No water quality degradation is indicated. OP appeared to decline between the EWQ and post-EWQ periods. However, differences in flow conditions, detection limits, potential laboratory artifacts, and too few post-EWQ samples produce uncertainty in the conclusion. Orthophosphate is unrelated to flow in both data sets. There were no independent data to confirm DRBC results. DRBC detection limits improved between the two periods, but concentrations are sufficiently high at this location that there were few undetected results in either data set.

Chapter 2: 1418 ICP
 Delaware River at Washington Crossing Bridge

pH, units

Existing Water Quality (Table 2Y):

Median 7.69 standard units
 Lower 95% Confidence Interval 7.52 standard units
 Upper 95% Confidence Interval 7.90 standard units



Kruskal-Wallis test

MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	115.5	2.31
1418 ICP DRWX Post	18	320.9	17.83

H statistic: 1.12
 X² approximation: 1.12
 DF: 1
 p-value: 0.2905¹

H0: $\theta_1 = \theta_2 = \theta_{...}$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j.
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. pH did not measurably change between the EWQ and post-EWQ periods. Under higher flow conditions, pH tends toward neutral. pH is inversely related to flow in the post-EWQ data.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

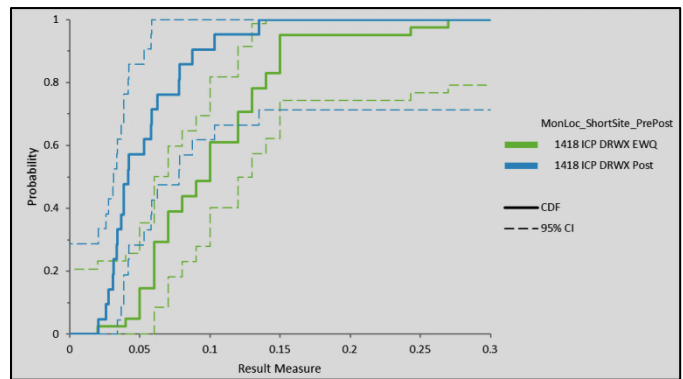
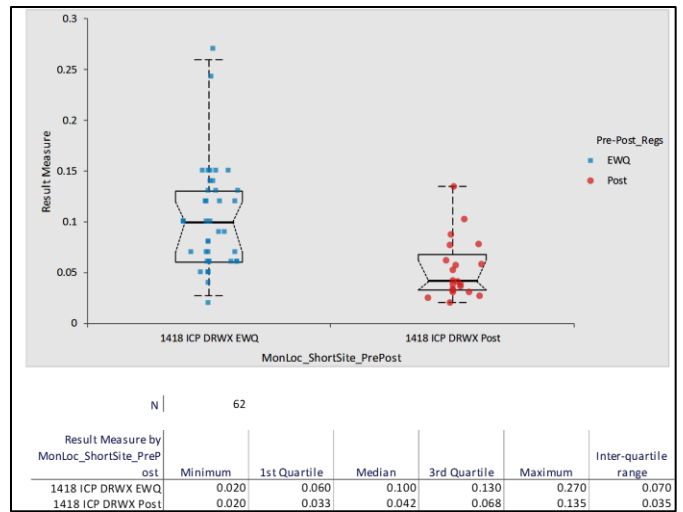
Phosphorus as P, Total (TP) mg/l

Existing Water Quality (Table 2Y):

Median 0.10 mg/l

Lower 95% Confidence Interval 0.07 mg/l

Upper 95% Confidence Interval 0.12 mg/l



Kruskal-Wallis test

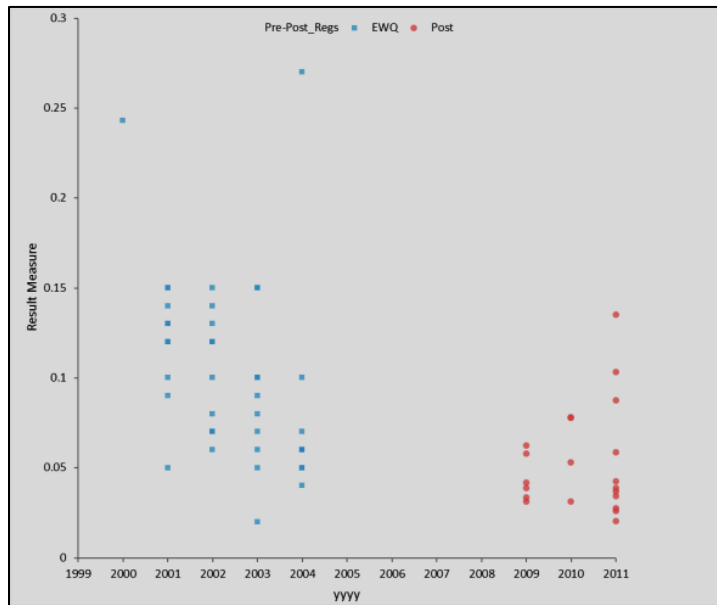
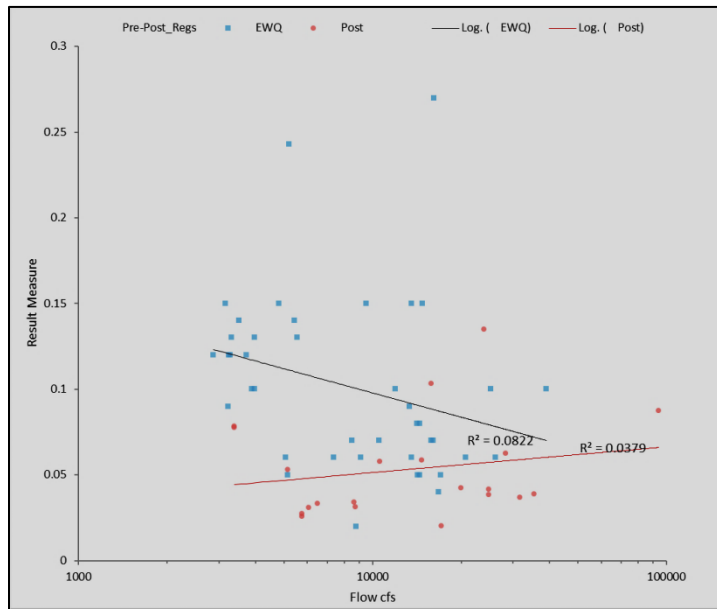
Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	41	1905.4	46.47
1418 ICP DRWX Post	21	3720.0	177.14

H statistic: 17.33
 X² approximation: 17.33
 DF: 1
 p-value: <0.0001¹

H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i, j
 The median of the populations are not all equal.

¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.

No water quality degradation is indicated. Total Phosphorus (TP) concentrations appeared to decline significantly between the EWQ and post-EWQ periods. However, differences in flow conditions, detection limits, potential laboratory artifacts, and too few post-EWQ samples produced uncertainty. TP is unrelated to flow in both data sets. There were no undetected results in either data set. No independent data were available to confirm these results.



Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

Specific Conductance $\mu\text{mho/cm}$

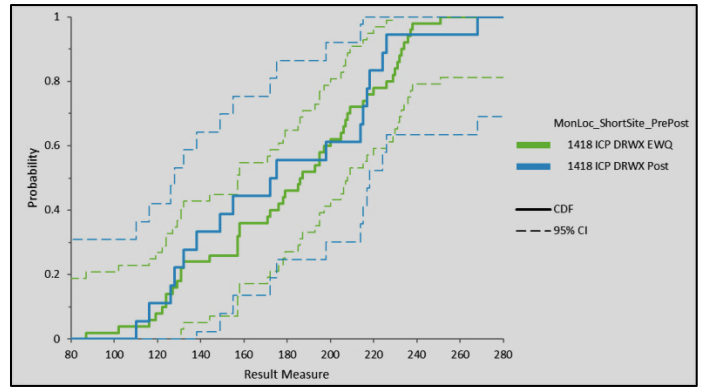
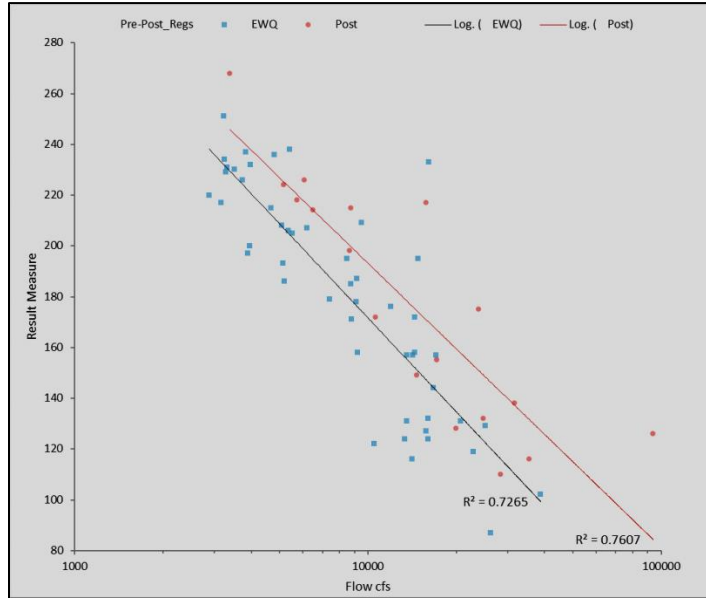
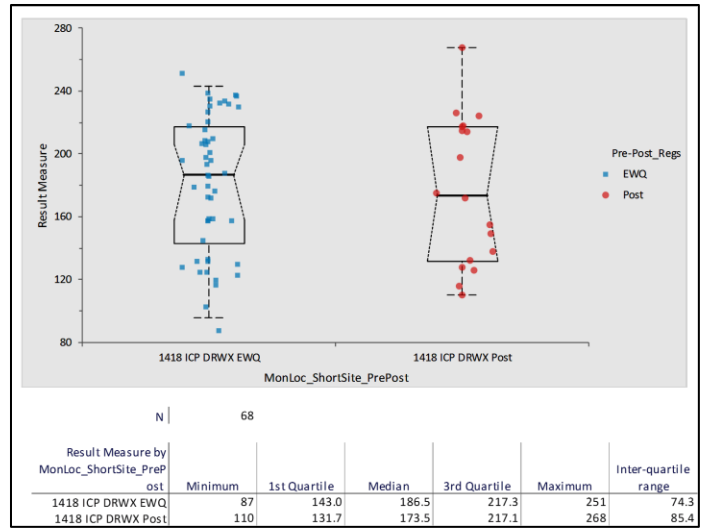
Existing Water Quality (Table 2Y):

Median 187 $\mu\text{mho/cm}$

Lower 95% Confidence Interval 158 $\mu\text{mho/cm}$

Upper 95% Confidence Interval 206 $\mu\text{mho/cm}$

Defined in regulations as a flow-related parameter

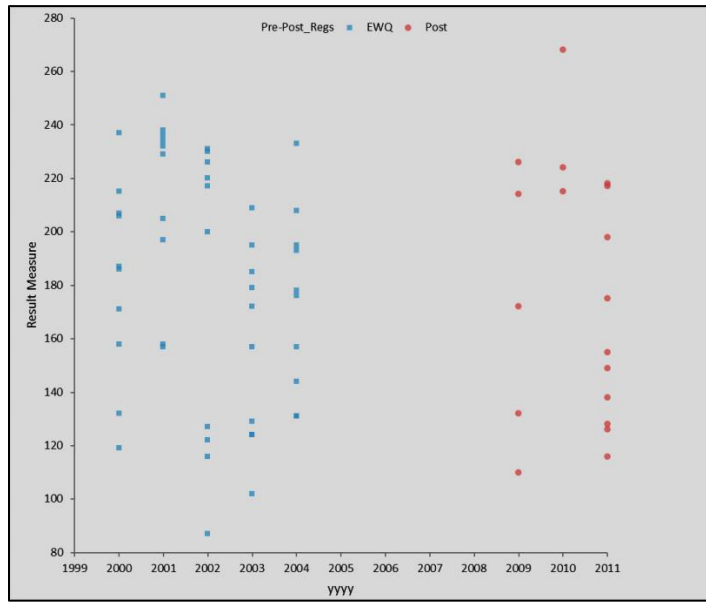


Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost		n	Rank sum	Mean rank
1418 ICP DRWX EWQ		50	24.5	0.49
1418 ICP DRWX Post		18	68.1	3.78

H statistic: 0.24
 X² approximation: 0.24
 DF: 1
 p-value: 0.6265¹

H0: $\theta_1 = \theta_2 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.



Some evidence of water quality degradation is indicated. Specific conductance did not measurably change between the EWQ and post-EWQ periods. In both data sets, specific conductance is inversely related to flow. In the post-EWQ data, low-flow conditions are under-represented – with the higher flow driving the median concentration down, even though post-EWQ concentration appears to be about 10 $\mu\text{mho/cm}$ higher on the flow relationship graph. Post-EWQ median specific conductance fell within the EWQ 95% confidence intervals.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

Total Dissolved Solids (TDS) mg/l

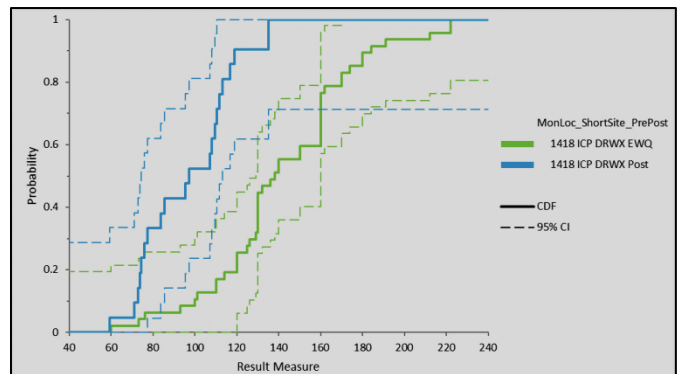
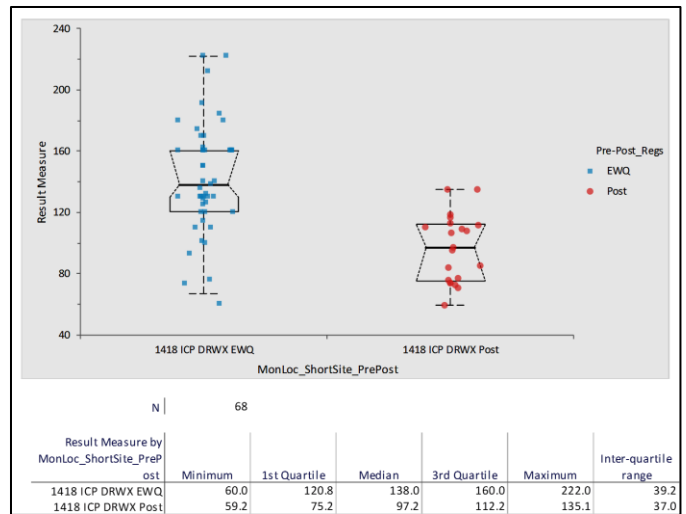
Existing Water Quality (Table 2Y):

Median 138 mg/l

Lower 95% Confidence Interval 130 mg/l

Upper 95% Confidence Interval 160 mg/l

Defined in regulations as a flow-related parameter

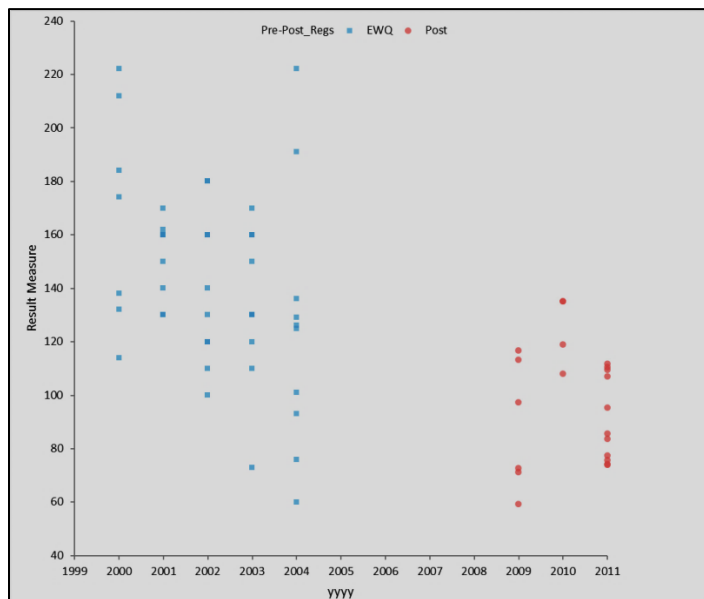
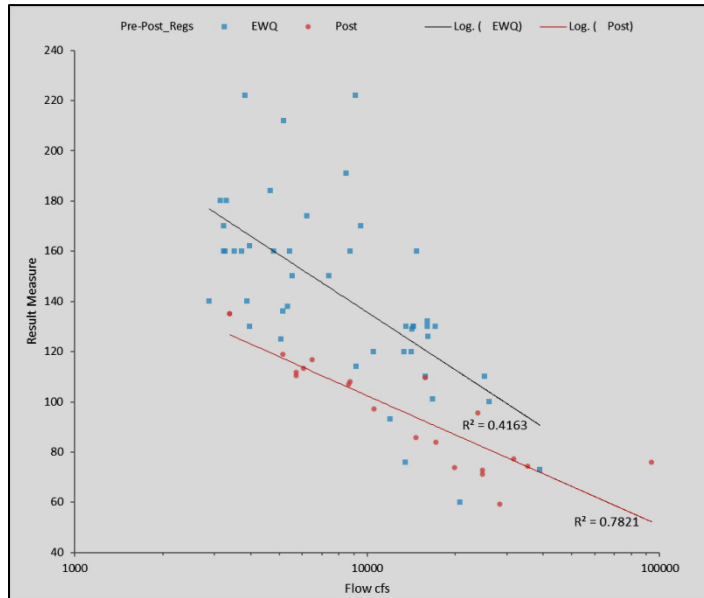


Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	47	2826.8	60.14
1418 ICP DRWX Post	21	6326.7	301.27

H statistic: 23.47
 X² approximation: 23.47
 DF: 1
 p-value: <0.0001¹

H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i,j.
 The median of the populations are not all equal.
¹ Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.



No water quality degradation is indicated. TDS apparently declined between the EWQ and post-EWQ periods. However, differences in flow conditions, potential laboratory artifacts, and too few post-EWQ samples produced uncertainty in the conclusion. TDS is inversely related to flow. Post-EWQ median TDS was below the EWQ 95% lower confidence interval, and post-EWQ TDS range was narrower than EWQ TDS. Post-EWQ detection limits were lower than EWQ detection limits, though there were no non-detect results even in 2000 when the detection limit was 20 mg/l.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

Total Suspended Solids (TSS) mg/l

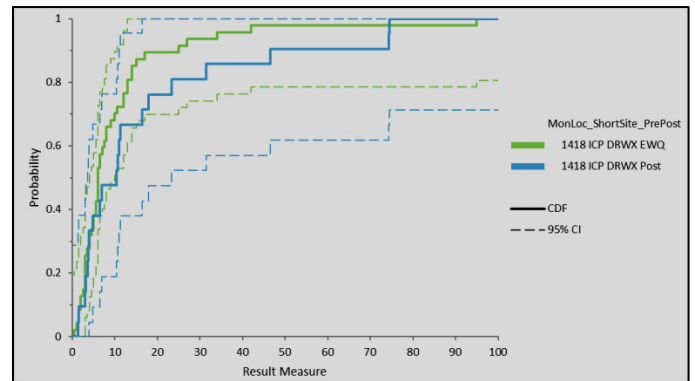
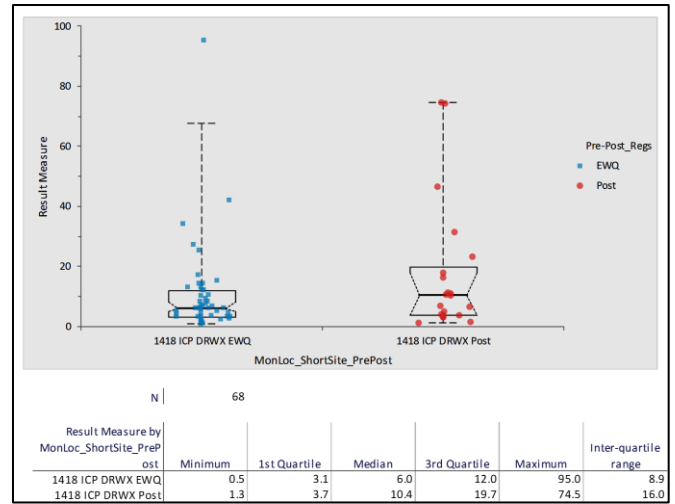
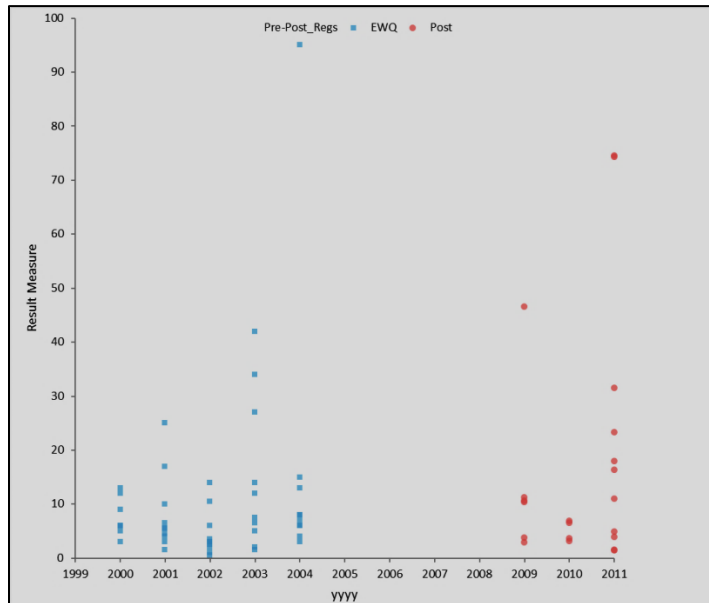
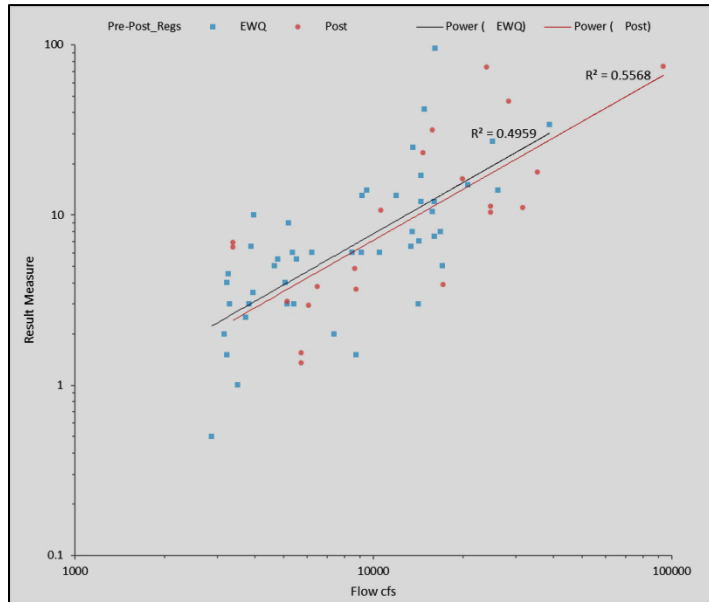
Existing Water Quality (Table 2Y):

Median 6.0 mg/l

Lower 95% Confidence Interval 5.0 mg/l

Upper 95% Confidence Interval 8.0 mg/l

Defined in regulations as a flow-related parameter



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	47	137.9	2.93
1418 ICP DRWX Post	21	308.6	14.69

H statistic: 1.14
 X² approximation: 1.14
 DF: 1
 p-value: 0.2850¹

H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i, j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. TSS did not measurably change between the EWQ and post-EWQ periods. However, potential laboratory artifacts and insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. TSS is positively related to flow in both data sets. Post-EWQ median TSS was well above the EWQ upper 95% confidence interval, but this was only because low-flow conditions were under-represented in the post-EWQ data. Both distributions were similarly shaped. On the flow vs. concentration graph, both flow and concentration are plotted on a logarithmic scale, and the regression is a power relationship.

Chapter 2: 1418 ICP
 Delaware River at Washington Crossing Bridge

Turbidity NTU

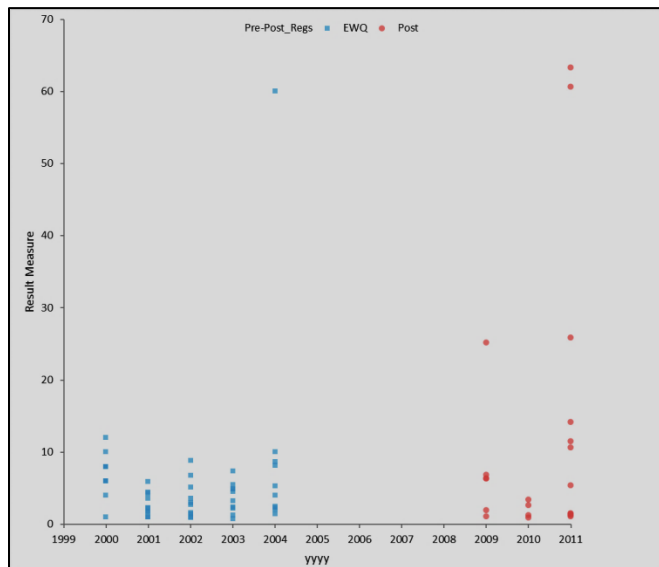
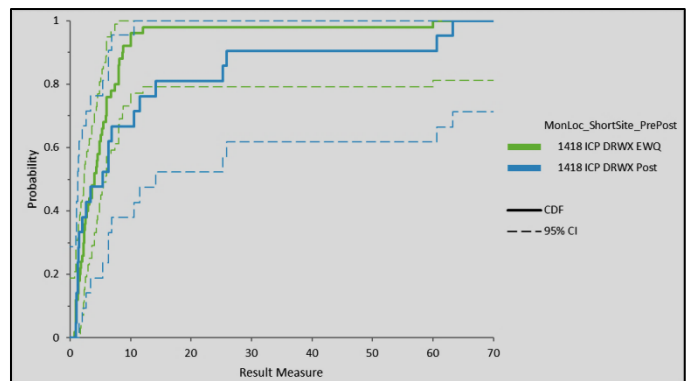
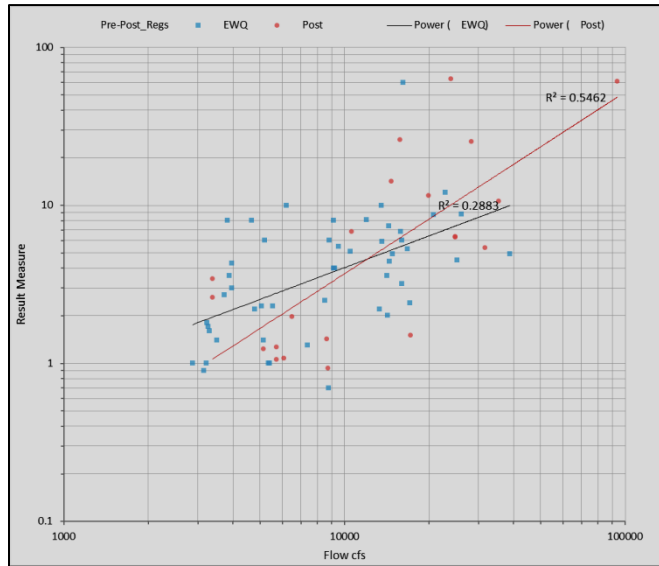
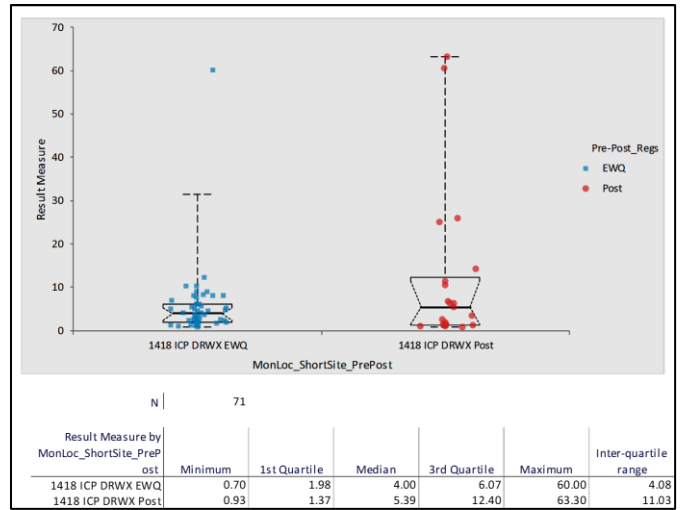
Existing Water Quality (Table 2Y):

Median 4.0 NTU*

Lower 95% Confidence Interval 2.4 NTU

Upper 95% Confidence Interval 5.3 NTU

*Should have been designated in rules as flow-related



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	79.4	1.59
1418 ICP DRWX Post	21	189.0	9.00

H statistic: 0.63
 X² approximation: 0.63
 DF: 1
 p-value: 0.4273¹

H0: $\theta_1 = \theta_2 = \theta_3 = \dots$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i, j
 The median of the populations are not all equal.
¹ Do not reject the null hypothesis at the 5% significance level.

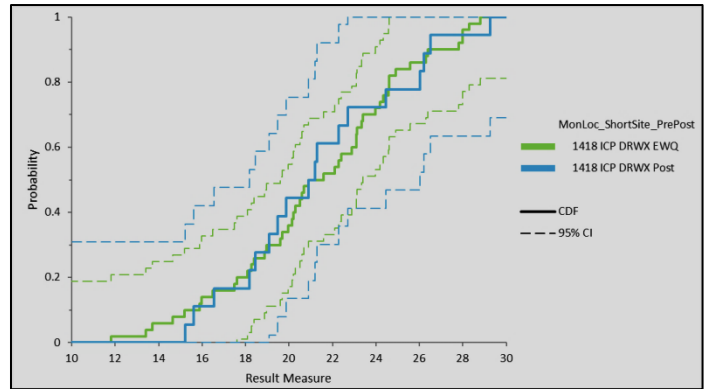
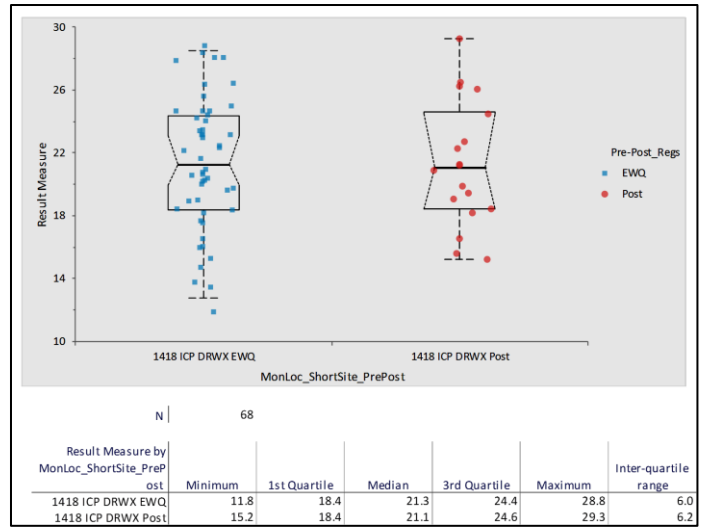
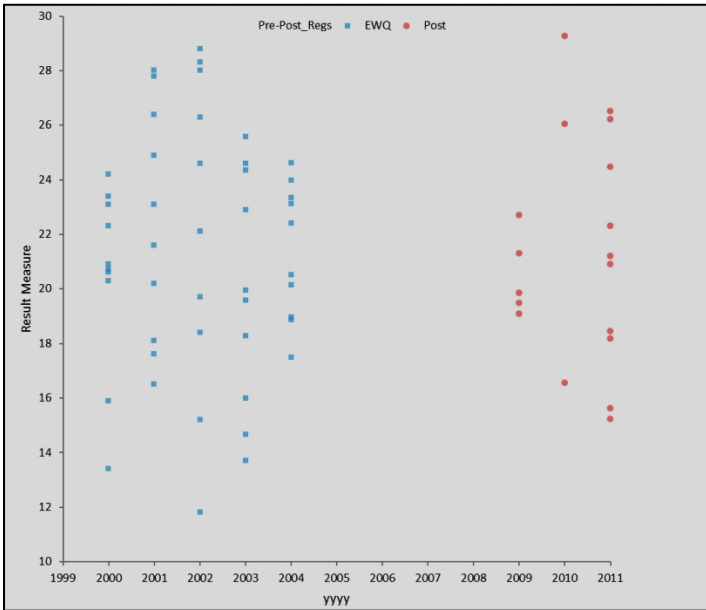
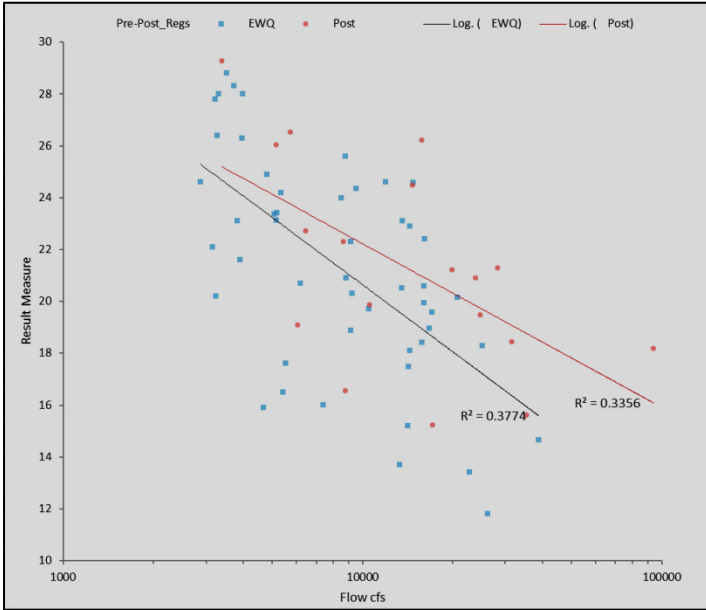
No water quality degradation is indicated. All but five post-EWQ turbidity results were within the expected EWQ range of 0-15. All five were taken during high flow conditions. However, insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. The post-EWQ median turbidity was well above the EWQ upper 95% confidence interval of the median, but overall turbidity did not measurably change between the EWQ and post-EWQ periods. In both data sets, the turbidity vs. flow relationship is weakly positive. Post-EWQ N was far less than EWQ N, and dry-weather samples were under-represented in the post-EWQ data set.

Chapter 2: 1418 ICP

Delaware River at Washington Crossing Bridge

Water Temperature, degrees C

Not included in DRBC Existing Water Quality rules



Kruskal-Wallis test

Result Measure by MonLoc_ShortSite_PrePost	n	Rank sum	Mean rank
1418 ICP DRWX EWQ	50	2.2	0.04
1418 ICP DRWX Post	18	6.1	0.34

H statistic: 0.02
 X² approximation: 0.02
 DF: 1
 p-value: 0.8839¹

H0: $\theta_1 = \theta_2 = \theta...$
 The median of the populations are all equal.
 H1: $\theta_i \neq \theta_j$ for at least one i, j .
 The median of the populations are not all equal.

¹ Do not reject the null hypothesis at the 5% significance level.

No water quality degradation is indicated. Water temperature did not measurably change between the EWQ and post-EWQ periods. However, insufficient post-EWQ sampling (n=21) introduced analytical uncertainty. Water temperature is inversely related to flow, though the relationship is weak. The distributions were similar, except post-EWQ minimum and maximum temperatures were higher than EWQ temperatures.